The Air Quality Lens: Ambiguity as Opportunity to Reactivate Environmental Data

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ABSTRACT
The use of low-cost sensors to collect environmental data can enable citizens to express environmental concerns and foster community building and activism. However, when made public, citizen data is often detached from the subjective experiences integral to citizen sensing. Our work with youngsters from diverse backgrounds explores how existing environmental datasets can be reactivated to engage new stakeholders and discussions. We present a research through design project with air quality data and draw attention to the role of ambiguity in our design process. We synthesize our reflections by discussing three design aspects that can make sense of ambiguity and encourage critical engagements with environmental data. Our goal is to offer a design-oriented account of how citizen-generated environmental data can be reactivated to express matters of concern.

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Citizen sensing; environmental data; design things; ambiguity; air quality

CSS Concepts
• Human-centered computing~Human computer interaction (HCI)

INTRODUCTION

All over the globe, citizen sensing initiatives enable communities and individual citizens to collect environmental data from their surroundings. Whether it is air quality in economically vulnerable [42] or industrialized [16] communities, noise pollution in dense urban areas [7] or soil in a community garden [22], low-cost sensors and do-it-yourself kits have made environmental monitoring accessible to a wide range of audiences [18]. Although the reliability of low-cost sensors and the use of citizen data in science and policy making is sometimes contested [4,19], citizen sensing initiatives can supplement official measurements with data that is less precise but has a higher spatial resolution [19]. Moreover, citizen sensing should also be understood through a lens of community building, citizenship and storytelling [31]. Indeed, while a sensor in its essence is just a tool to collect data, it can also become a *design thing* [12] around which environmental concerns, new alliances, socio-political realties and conflicting interests emerge. In other words, sensing environmental data, and the assemblies of social, political, material and (non-)human actors that emerge in the process, is a way of engaging with environmental issues as what Latour would describe as a *matter of concern* [34].

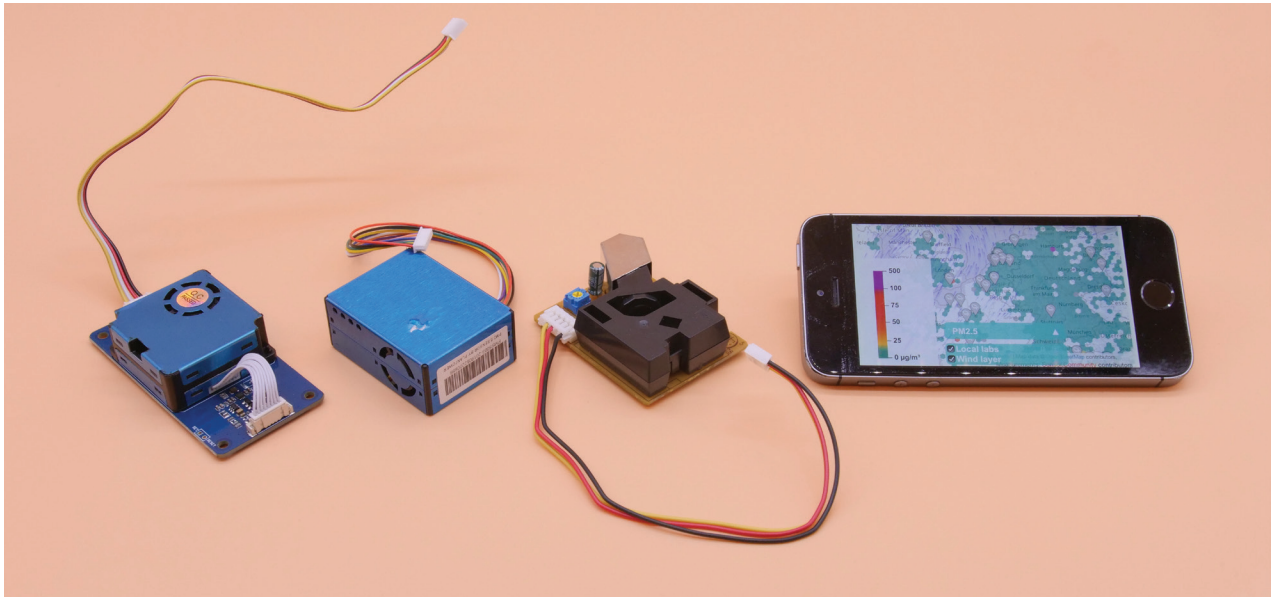
However, the data collected in citizen sensing initiatives often ends up on an online platform (either specifically built for the project, or a global initiative like Sensor.Community[1]), where it is available to a wider audience, but at the same time detached from its original context [38]. As such, the questions that played a central role during sensing (e.g., "what to measure", "where", "with who" and most importantly "why") disappear into the background and make place for graphs and numbers, that are presented as, to use Latour's words again, a *matter of fact* rather than a matter of concern.

In this pictorial, we reflect on how environmental data can be reactivated to express matters of concern. To this end, we will draw attention to the role of *ambiguity*. Drawing on the work of Gaver [20], we refer to ambiguity as the quality of a design to allow multiple interpretations, which in the right context can make it more engaging and thought-provoking for the user. To highlight the potential of ambiguity when designing with environmental data, we will present and discuss an "air quality lens" that we developed as part of a participatory storytelling project on climate change. The air quality lens was conceived as a research through design project, and in this pictorial we will also describe its design, development and use, as a way to stage encounters with ambiguity. We will then highlight three aspects of our design that helped us to productively make use of ambiguity and encouraged our participants to critically engage with environmental data.

Our main contribution then, is to offer a design-oriented account of how existing citizen-generated environmental data can be reactivated to express matters of concern.

Before going on to the design process of the air quality lens, we will first elaborate on matters of fact and matters of concern in design and align our contribution with existing work in citizen sensing and environmental data.

1 https://sensor.community



different low-cost particulate matter sensors next to the real-time map of the Sensor.Community project

ENVIRONMENTAL DATA: FROM MATTER OF FACT TO MATTER OF CONCERN

The distinction between matters of fact and matters of concern was put forward by sociology and STS scholar Bruno Latour as a reflection on truth and representation in politics [33,34]. In essence, Latour uses these terms to describe two different ways to look at contemporary democratic processes. Matters of fact indicate the idea that there exist universally proven facts, separate from political, economic, or socio-cultural conditions, that can be relied on to make objective and independent decisions. Matters of concern on the other hand, embrace a plurality of assertions rather than singular facts, which in turn draws attention to the broader representation of social, political, material, human and non-human actors that emerge around any given issue. In our globalised

and increasingly polarised society, Latour argues, a shift towards matters of concern allows to "slowly proceed from a very simple-minded form of cohabitation – such as the evolutionary or revolutionary ones – to a much fuller one, where more and more elements are taken into account" [34].

Consequently, when we criticise the representation of environmental data as a matter of fact, it is not to imply that the data is false or unusable. We do, however, suggest a need for work that goes beyond "official" ways of representing environmental data — maps with coloured overlays, numbers, and graphs. Just like citizen sensing has brought pluralistic alternatives to regulatory monitoring systems and thus questioned what counts as normative [12,23], a similar shift in how the resulting data is represented, (re-)used and acted upon could create more openness and allow a wider range of stakeholders to engage with the data.

DiSalvo et al. [12,28] and Binder et al. [1] offer perspectives from HCI and Participatory Design, on how matters of concern can be expressed through design. Their work brings up the concept of design things; design that allows for a diversity of perspectives [2], raises questions on agency of designers, users, but also non-human actors [15] and articulates problematic situations [12]. While we highly value this scholarship for expressing the role of design as a public practice [2,12,28,35], design things are intertwined with many other disciplines (e.g., speculative critical design [14], adversarial design [10], social design [3]) and concepts (e.g., publics [9], infrastructuring [8], agonism [41]). As such, it remains a rather heterogeneous concept that we, as designers, have found difficult to grapple with practically. That is why this pictorial puts forward the notion of ambiguity as one possible perspective to understand design things in the light of environmental data.

RELATED WORK

Visualising environmental data

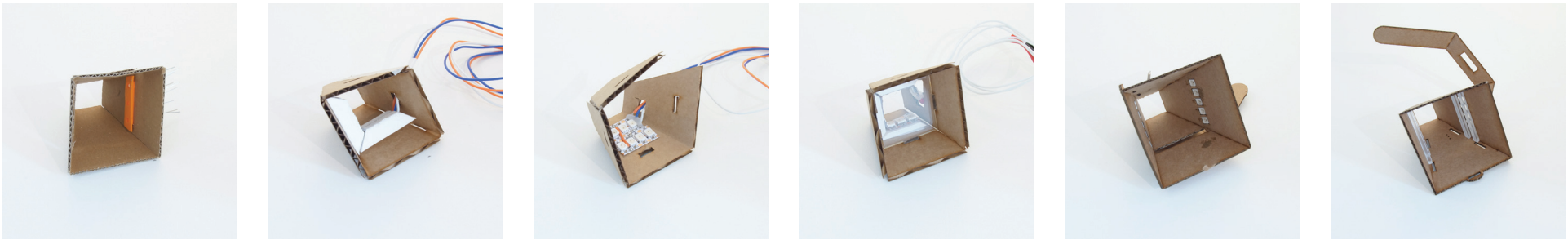
There have been endeavours in the HCI community to engage with environmental data in more open-ended ways. For instance, t-shirts [29] and balloons [30] that light up or change colour in response to air quality, a system to capture videos of factory smoke in addition to particulate matter sensor data [24], a device that slowly visualises CO2 levels by scorching paper discs [26], or VR and AR applications that make pollution particles visible [40,45,48]. While most of these examples still draw on established ways of visualising data by using colours, numbers or simplified graphs, a look at arts-based research yields more speculative approaches. For example, photographer Kristof Vrancken [49] uses an analogue photography process that involves developing photos in an emulsion of red cabbage, as a bioindicator for soil quality. Gabrys [17] has speculated on the qualities of lichens as a bioindicator for environmental pollution that could draw attention to how environmental change takes place over the span of multiple human lifetimes. And Offenhuber [44] has visualised air pollution through the physical impact of particulate matter on the built environment, and in [43] worked with patterns on plant leaves as a bioindicator for ozone.

In our work, we explore the potential of bringing together the creative approaches to sensor data from HCI with the speculative approach towards environmental data in arts-based research.

Narrating environmental data

Dourish and Gómez Cruz have argued that "data do not speak for themselves" [13] and must be narrated in order to be understood. Recently, Liu et al. [38] have elaborated on this scholarship in relation to environmental data specifically. Their work describes high-level design strategies to narrate data and bridge the gap between objective environmental realities and subjective experiences of the environment. Similarly, Coulson et al. have introduced the concept of "community level indicators" [7] as an interface between sensor data and lived experience. Gabrys et al. mobilise the concept of "just good enough data" [19] to describe how storytelling can complement and legitimise incomplete citizen-generated for influencing policy making. The work of Heitlinger et al. [22] with soil sensors in a community garden also shows how letting people interpret environmental data in relationship to their own practices, can show the different meanings present in the same dataset.

Building on this body of work, we make a design-oriented contribution, by exploring how the idea that "data do not speak for themselves" could be supported by and expressed through the designed qualities and aesthetics of design things that engage with environmental data.

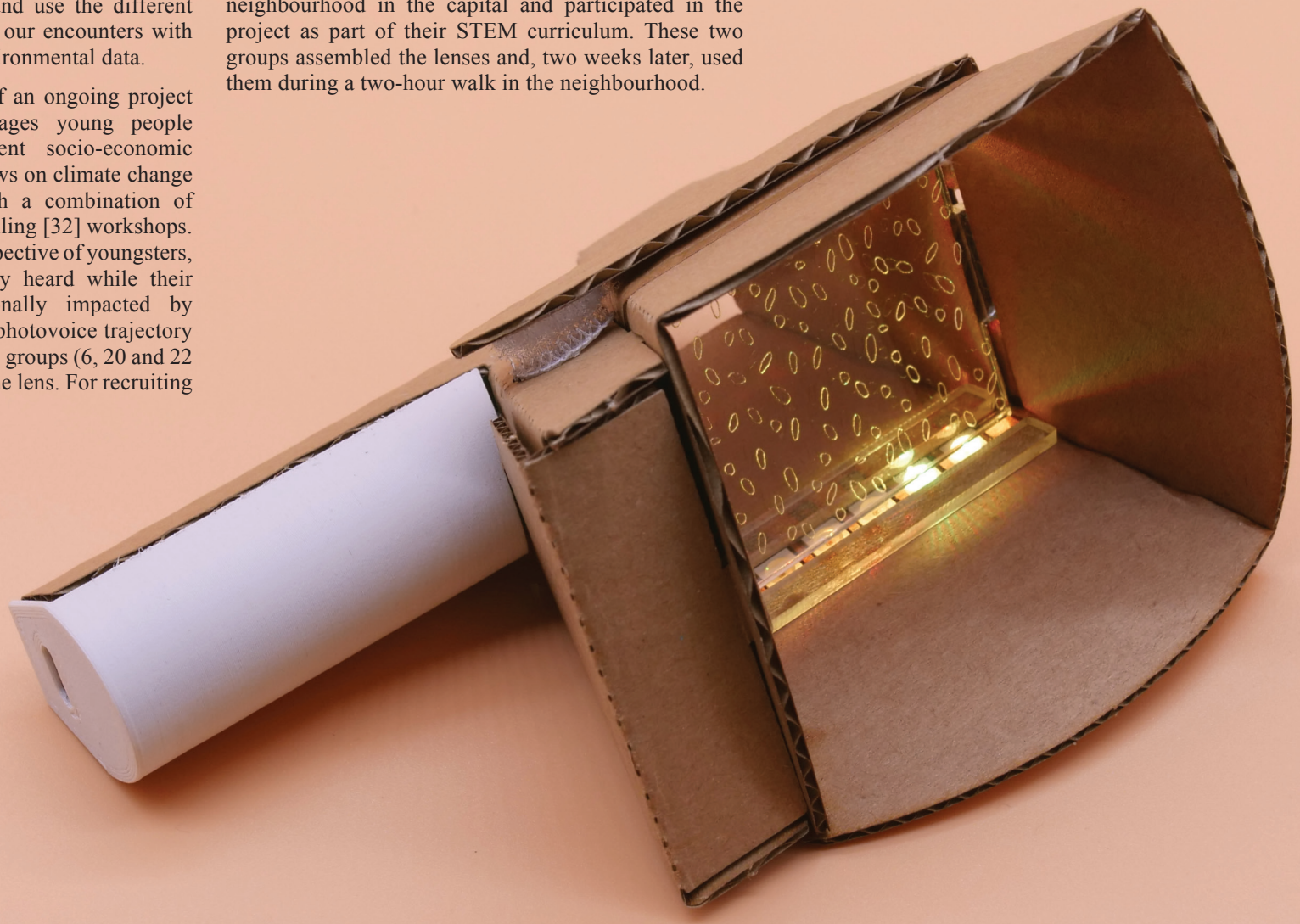


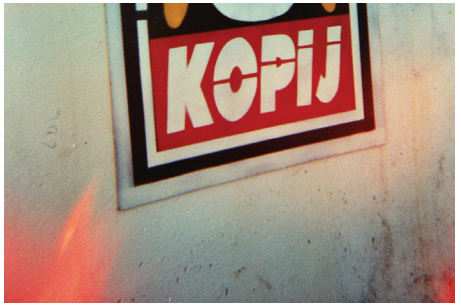
early iterations of the air quality lens (presented on the next page)

THE AIR QUALITY LENS

In this section, we present the air quality lens, the result of a research through design process by the first author of this pictorial. The air quality lens (hereafter referred to simply as "the lens") is a device that can be placed in front of a smartphone or point-and-shoot camera, to alter photographs based on real-time data from nearby air quality sensors. We will present the design process from initial idea to deployment and use the different stages in the process to reflect on our encounters with ambiguity while working with environmental data.

The lens was conceived as part of an ongoing project ("Climate Stories") that encourages young people (aged 12 to 15) from different socio-economic backgrounds to articulate their views on climate change and environmental issues through a combination of photovoice [47] and digital storytelling [32] workshops. Climate Stories focuses on the perspective of youngsters, as their voice is less prominently heard while their generation will be disproportionally impacted by climate change [6]. As part of the photovoice trajectory in the Climate Stories project, three groups (6, 20 and 22 participants) assembled and used the lens. For recruiting the participants of the first group (6 participants), we collaborated with an NGO that offers a safe space to youngsters from disadvantaged families in a provincial capital. This group assembled the lens but did not use it in the rest of the photovoice trajectory. The other two groups (20 and 22 participants) were recruited in collaboration with a high school in a multicultural neighbourhood in the capital and participated in the project as part of their STEM curriculum. These two groups assembled the lenses and, two weeks later, used them during a two-hour walk in the neighbourhood.





↑ examples of light leaks in analogue photography: when light inadvertently reaches the film, it creates colored streaks or diffuse overlays on the photo

Background and constraints

The Climate Stories project originated as a follow-up to a citizen science initiative that had just established a real-time network of low-cost particulate matter sensors in a provincial capital in Belgium. We thus wondered how we could integrate (the data from) these newly placed sensors in the photovoice trajectory with our participants. From early in the project, this brought the focus to using existing data, rather than building or deploying our own sensors. Given their age and socio-economic background, not all participants owned a smartphone with mobile internet access (i.e., to use a smartphone application that displays live air quality data). Because we wanted to integrate air quality data in the photovoice trajectory, we chose to build a stand-alone object that could work with a smartphone camera, but also with point-and-shoot cameras we provided.

Encounters with ambiguity

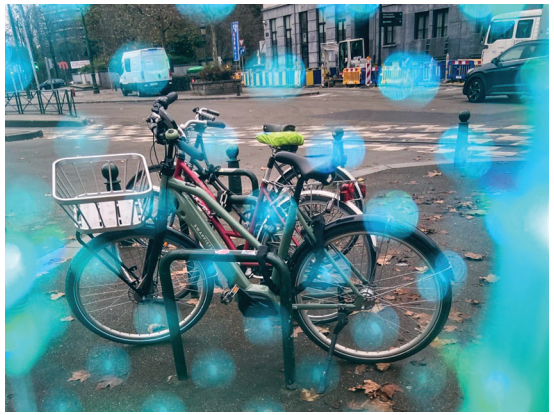
Early in the project, one of the partners voiced concerns that air quality data from low-cost sensors can easily be misinterpreted when using momentary sensor readings instead of long-term averages. This prompted us to think how we could reconcile the changing nature of air quality data with the momentary frames that would be captured with the photovoice method. During our explorations, we got inspired by light leaks that may inadvertently occur in analogue photography. Our experiments showed that the colour and shape of light leaks can be an indicator for the brightness of the light and the position of the leak, while still looking unique on every photo. We tried to recreate this experience from analogue photography with the lens, to create a visualisation of air quality data that could be traced back to simple parameters but would change dynamically and organically.

The lens

The body of the lens is made of cardboard and 3D printed PLA. Inside, it has 10 RGB LEDs that sit around the edges of a removable transparent acrylic sheet with engraved patterns. When looking through the lens, the LEDs light up the patterns on the acrylic sheet, creating a semi-transparent overlay on the image.

The colour and intensity of the LEDs is driven by real-time data from nearby particulate matter sensors. Inside the handle of the lens is a microcontroller with Wi-Fi capabilities (ESP8266) and a GPRS module (SIM800). By repeatedly scanning the MAC addresses of all Wi-Fi networks within reach, we can use Google's Geolocation API to determine the position of the user with an average accuracy of ±25 meter (in an urban environment). Once the system has determined its location, it contacts the API of the Sensor.Community project — a database of air quality data collected by over 10.000 particulate matter sensors in cities all over Europe, placed and maintained by volunteers. During our tests in an urban environment, this usually resulted in real-time air quality data from 3 to 5 sensors within a 2km radius.

↓ examples of photos made with the air quality lens



The lens also contains an accelerometer, gyroscope and magnetometer combination that functions as a tilt-compensated compass. This way, the patterns of light move around as the user turns left or right, like a compass that points towards nearby air quality sensors (e.g., when facing North, a greenish glow of light on the top right of the photo would mean there is a sensor measuring relatively good air quality towards the Northeast, while a red glow on the left would mean there is a sensor measuring poor air quality towards the West).

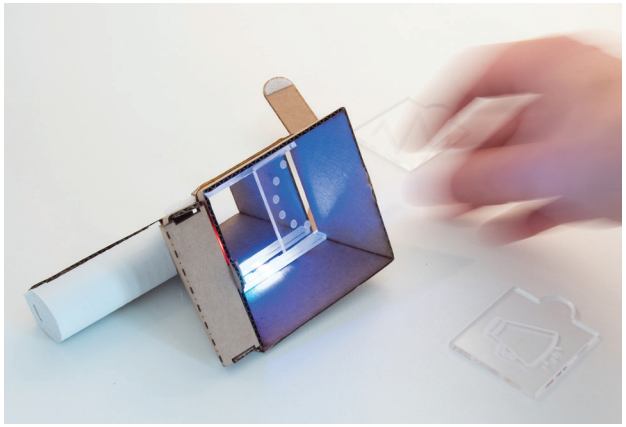
Encounters with ambiguity

During our experiments with the Sensor.Community API, we realised that the sensor network would look quite dense on a map, while the sensors could still be relatively far away on a human scale. In translating this experience to our design, we drew inspiration from the pseudoscientific practice of using a dowsing rod, so that our design could indicate the presence of air quality data, without pinpointing it to an exact location. Drawing on Gavers tactics for enhancing ambiguity of information [20], we translate relatively precise geolocation and compass data, to a low-resolution "display" of only 10 LEDs. By doing so, we can take away doubts about the accuracy of the data (making it "perceptually undemanding" [20]), but still motivate users to fill in with their own interpretation.

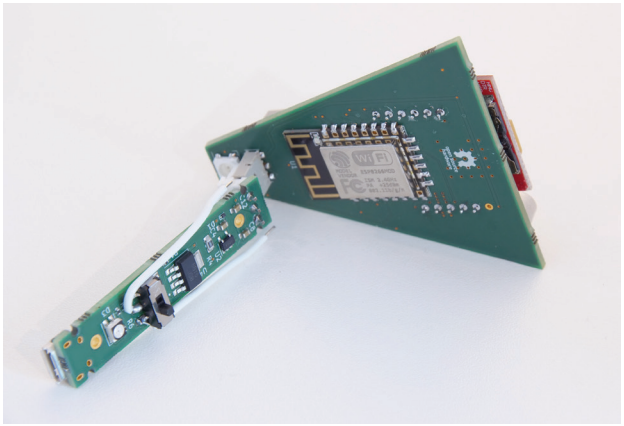
From prototype to kit

In the first prototypes we experimented with different positions for the LEDs and acrylic sheet, to create overlays on the photo without influencing the camera's ability to autofocus. Once everything was roughly positioned, we made a high-fidelity prototype by using a laser cutter to cut the shape and folding lines in a sheet of 3mm corrugated cardboard. Throughout this process, we started seeing opportunities to let the lens in part be assembled by the participants themselves.

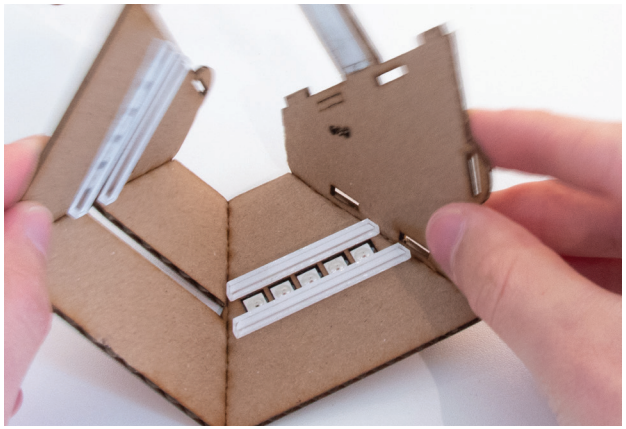
We eventually followed a workflow inspired by [35], laminating and selectively cutting layers of cardboard, led strip, conductive copper tape and heat-resistant foil inside the laser cutter, to integrate the LEDs in the cardboard body of the lens. The remaining electronics, acrylic sheet and 3D printed parts were packed with the cardboard to create a kit that could be assembled in ± 30 minutes. In the end, we made 20 such kits with a laser cutter and 3D printer, which took roughly two weeks, constantly improving the process and fixing small errors in the design files. In the meantime, the PCBs for the microcontroller and battery circuit that we designed were produced and partially assembled by a local commercial service.



detail 1: removable acrylic sheet



detail 2: electronics inside the lens

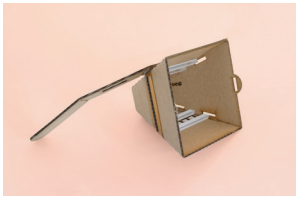


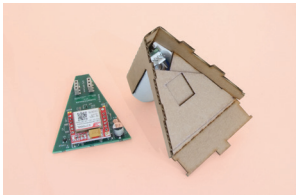
detail 3: LEDs integrated in the cardboard

detail 4: the lens in front of a smartphone camera

Encounters with ambiguity

So far, our encounters with ambiguity showed opportunities to act on the temporal and spatial characteristics of air quality in our design process. However, to quote Gaver [20], "ambiguity is not a virtue for its own sake". Literature on seamfulness [5,25]

the kit and some of the steps in the assembly process

brings up the theme of uncertainty and appropriation – in this context is strongly related to ambiguity [25] – but also draws attention to the visibility and invisibility of systems. As the prototype evolved, we worried about creating too much of a "black box", that would obfuscate the relation between the air quality data and the photos made with the lens.

Inspired by the way do-it-yourself tools like Google Cardboard[2] or RePhone[3] provide some insight in VR and cell phone technology respectively, we took the opportunity to structure the lens as a do-it-yourself project, to literally make some of the inner workings of the lens visible. We considered that by letting the participants assemble the electronics and acrylic sheet parts, they could discover in a hands-on manner how, for example, technical issues might be related to the battery, or how the light gets diffused through the engraved acrylic sheet — before engaging with the lens as a whole.

Assembling the lens

Assembling the lenses was done in a two-hour workshop. First, the participants got a short interactive presentation on air quality, health issues and factors that influence the concentration of particulate matter in the air. We then showed them the Sensor.Community platform, and explored the air quality map of the area we were in. During this part, the participants were rather passive (as could be expected at this age), sometimes talking between themselves and doodling. After this short presentation, we introduced the lens and its relation to the data from the Sensor.Community platform. They then got into groups of two or three and each group was handed a lens kit. The assembly process was guided by a step-by-step image slideshow with help from the workshop leaders where necessary.

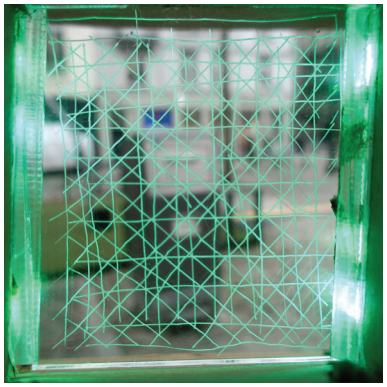
The proposition to assemble the lenses was initially met with scepticism ("Are we really going to build this

2 https://vr.google.com/cardboard/

3 https://wiki.seeedstudio.com/RePhone/

↑
patterns and drawings on acrylic sheets made by the participants during the workshop

→
heart shape on an moped with a combustion engine; dense pattern causing the subject of the photo (a litter bin) to be out of focus



←
a participant assembles the handle of the lens

ourselves?!"), but once the groups got their hands on the lens kits, they immediately started detaching and folding the cardboard, often without waiting for the next instruction. One participant, who had been lying face down on her desk during the introduction, got very involved in assembling the lens and noted at the end of the workshop: "I've always considered becoming a doctor, but now that I'm doing this, maybe I would like to be a designer, just like [first author]". Assembling eventually took between 30 and 45 minutes, revealing rather big differences in dexterity between groups. Our anecdotical evidence showed that groups of girls generally were faster and more independent.

Participants also had the possibility to customise the acrylic sheet that is used in the lens (to create patterns on the photos). We provided two unique examples with each kit, but also gave a clear piece of acrylic to encourage participants to create their own by scratching with a pair of scissors or the sharp end of a compass. Almost all groups tried this, and the results ranged from a few scratches to elaborate patterns and original drawings. This helped in the larger groups – where three participants were assembling one lens – to give everyone the opportunity to contribute to something. Two weeks after assembling – when we took the lenses out on the street – we also noticed that when the participants came to collect their lenses from the storage box, they recognised theirs mainly based on the patterns they created.

Encounters with ambiguity

Our rationale for customizing the acrylic sheet was, on one hand, a consideration for group dynamics during the workshop, and on the other hand offering an opening for the participants to appropriate their lenses. However, while we had expected simple patterns, some participants created more figurative drawings. This strongly influenced the look of the photos made through the lens and created interesting juxtapositions. In some cases, the drawings also influenced the ability of the camera to focus through the acrylic sheet, drawing more attention to the data, and bringing the subject of the photo to the background. This added another layer of ambiguity to the photographs, which we had not foreseen, but was caused by the way our participants had appropriated the lens.

Using the lens

Two weeks after assembling the lenses, we went outside with the participants for a two-hour walk, making short stops on different types of places along the way: a small park, a Christmas market, a busy traffic intersection and a bridge over a canal used for inland waterway transport. While participants collected photos for the digital stories they would later make, we observed their use and experience with the air quality lens. At every stop, we did a short show and tell with the whole group where two or three participants were asked to share their favourite photograph from that location.

During the walk, we observed how participants photographed different subjects they related to air quality. This included obvious sources of pollution (e.g.:

busy traffic or construction sites), but also photos where the subject was deliberately matched with the current reading (e.g.: when the lens showed a green overlay, they would look for elements in the area that could positively influence the air quality). Participants also discussed their photos amongst themselves, especially when the result did not match their expectations (e.g.: a green overlay when photographing a car exhaust), or when there were conflicting views in a group (e.g.: between the impact of a moped, electric moped, and a classic bicycle).

Encounters with ambiguity

The encounters with ambiguity during use could roughly be divided in two categories.

The first denotes a tension between the air quality data and the experience of the participants — what Gaver would refer to as "ambiguity of information" [20]. The walks with the lens took place during a cold day, with an open sky and strong winds, resulting in favourable readings from most particulate matter sensors and the lens creating mostly green overlays on the photographs. This contrasted, however, with the experience of the participants and some of the subjects they chose to photograph (e.g., large trucks, traffic jams and barges). However, upon talking to the group and reminding them of the introduction session we had about air quality, discussion took place on conditions that can improve air quality (e.g., strong winds with clear skies) but also on the source of the data (e.g., the sensor providing the data could be a few 100 meters away from the current location or mounted high up on a balcony rather than on street level). Thus, the participants reflected not only on air quality itself, but also on sensing and data visualisation practices.

The second category applies to ambiguity between the subjects in the photographs and the intention of the participants. Unlike the ambiguity of information, this was something we didn't anticipate as much. For example, during our stop on the Christmas market most participants took a photo of the big wheel. When asked why, the explanations differed between groups. Some took a photo of the wheel just because they liked how it looked, one group showed concerns about pollution caused by the temporary construction of the wheel, and

a particpants talks about their favorite photo during a show and tell on one of the stops ↓

↑ photos illustrating the two categories of encounters with ambiguity during use

others “because it uses a lot of electricity, for all the lights and to make it turn”. Further discussion showed that these last groups were aware that the electricity was produced somewhere else (and thus that the big wheel wouldn’t influence the air quality on that particular spot much), but still choose to photograph the big wheel as a symbol for (superfluous) electricity consumption.

DISCUSSION

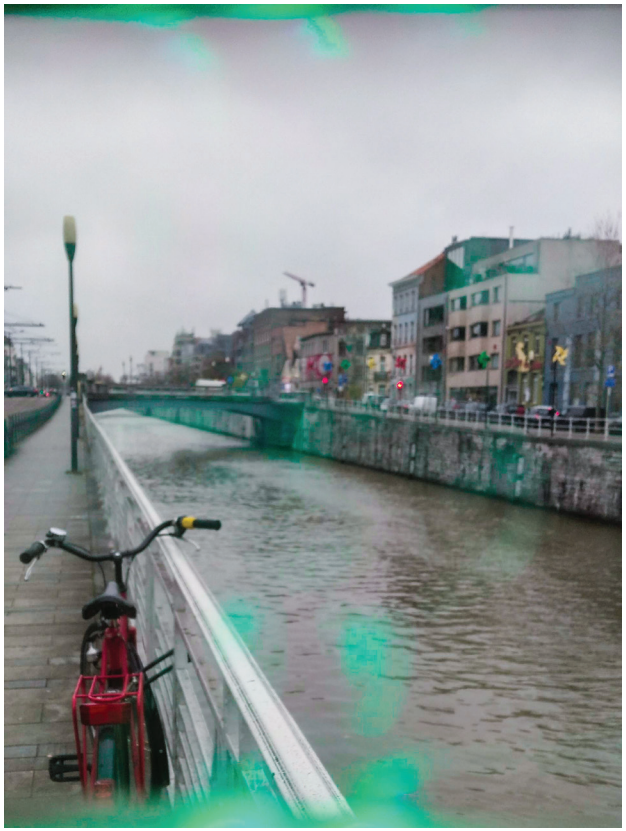
We showed how our research through design process was shaped by encounters with ambiguity. While designing, these encounters triggered us to rethink how an existing air quality dataset could be presented, used, and acted upon. While the participants were assembling and using the lens, we observed how ambiguity created a space for interpretation and discussion.

In the introduction of this pictorial, we brought up the question how environmental data can be reactivated to express matters of concern, rather than a matters of fact. On a macro-level, we observed how the lens triggered the participants’ interest in air quality data in a way that surpassed the map-based online visualisation. More concretely, we have shown how participants questioned air quality data in relation to the weather and the built environment, and how happy accidents and juxtapositions in the photos triggered discussion between participants. This points towards the ability of environmental data to articulate issues, trigger discussions, encourage multiple interpretations and, as such, express matters of concern. In what follows, we will highlight three design aspects that converged during our design process and encounters with ambiguity and discuss how they contribute to our goal of reactivating environmental data to express matters of concern.

Transposing

During the design of the air quality lens, we experienced environmental data in different forms and languages: coloured maps on the Sensor.Community homepage, time series graphs from our own experiments with particulate matter sensors, coordinates and values in API calls, and sequences of light while testing the air quality lens. This developed our sensitivity for the particularities of the data at hand. Simultaneously, our encounters with ambiguity showed that the specific temporal and spatial characteristics of air quality data risk getting lost when translating or mapping the data from one form (e.g., a sensor reading) to another (e.g., a colour overlay).

In his work on translation, linguist Roman Jakobson says about poetry – where the relation between words is as important as their meaning – that it is “by definition untranslatable. Only creative transposition is possible” [27]. For Jakobson, a Russian poem transposed into dance or painting could be truer to the original than a literal textual translation to English. We suggest that a similar attitude to environmental data – transposing the objective measurement together with the ambiguity that stems from measuring – could help to express matters of concern



Chiefly, characterizing design practices with environmental data as transpositions rather than translations, draws attention to the affective register of datasets. With HCI showing a growing interest in non-human perspectives and the role of non-human actors in design [21,37,39,46], there also arises a need for new concepts, imaginations and design language [11]. While this pictorial brings up the idea of transposing as a reflection on our own research through design project with air quality data, we believe it could be an effective starting point for future exploration.

Layering

Our work with the air quality lens shows that the experience of environmental data consists of multiple layers. The dataset we used from the Sensor.Community platform already contains a first layer of stories, because it is constituted by large-scale publicly funded citizen science projects, grassroots community groups worried about a particular issue, or tinkerers merely curious to try out a new piece of technology. Our air quality lens then transposes the data to the medium of photography, which interweaves deliberate intentions (i.e., what the participants decide to capture and how to frame it), and external conditions (i.e., sunlight or the camera’s ability to focus) that all influence how the photo will look. Additionally, we’ve also shown how the acrylic sheets that were customised by the participants sometimes added another layer of meaning to the photographs.

This shows how not all the ambiguity that was introduced in our design was expected or intentional and that, even if we would have wanted to, not all of it could be controlled or even influenced by us as designers. Yet in the end, it is through all these different layers of ambiguity that not only a more open relationship between the interface and the end user is constituted

(the focus of Gaver's work), but also interpretations and conditions that stem from other (non-human) actors are communicated. Matters of concern are characterised by a diversity of perspectives [15]. Consequently, when we work with environmental data it should be through rich stories that interweave perspectives from different actors [13,38]. By allowing different layers of ambiguity to surface, the air quality lens becomes a tool with which such stories can be constructed.

Therefore, we would suggest that the process of reactivating environmental data to express matters of concern is not about trying to create an end-product, but to carefully construct a layer of meaning on top of existing stories, interpretations and conditions, while also leaving enough openings for new layers of design or appropriation to be added on top of that. The role of the designer then, is to balance; to create openness without frustrating the user; to make multiple voices heard without creating a cacophony; to speculate without losing science. Of course, we agree that such a complex interplay is not desired in all cases (e.g., strict regulatory monitoring), but could nonetheless form a valuable addition to existing and normative data practices.

Materializing

As described in the encounters with ambiguity, we considered that a do-it-yourself kit could potentially make the inner working of the lens more visible for the user. Therefore, during assembly, we were happy to observe how participants would start folding the cardboard and experiment with the other parts, without awaiting instructions. However, when we went out to use the lens two weeks later, participants would ask our help or approval to fix even minor damages like loosened tape or bended cardboard parts — the design had turned into a black box again. Nonetheless, we could still observe a certain nonchalance when handling the air quality lenses. Two groups dropped their lens, while others would cram it into their pockets while walking, dangling and ready to fall out any moment. In contrast, the cheap digital point-and-shoot cameras that were handed out to the participants were handled very

carefully, although the bill of materials of the air quality lens and the purchase price of the camera was similar.

So while cardboard didn't necessarily achieve the intended transparency for the system, it did communicate other affordances to the participants. On one hand, cardboard is considered a cheap and adaptable material. Notwithstanding the electronics inside, the participants assumed that if something broke, it would be easy to fix or exchange. On the other hand, being designed to fold into a shape that is usually not associated with cardboard (i.e., not a box), the lens looked enough like a real product for the participants to consider it so. All in all, we would say that using cardboard contributed to the seamfulness of the air quality lens; it was accepted as a working device but still had a prototyping aesthetic that supported ambiguity and encouraged users to supplement the data visualisations with their own interpretations and beliefs.

Matters of concern are in a constant state of negotiation, so it is worthwhile for designers to experiment with a materiality that is transient and adaptable. This could be through physical materials like cardboard (as we tried), but in case of a digital interface could also be reflected in the graphic and interaction design.

CONCLUSION

In this pictorial, we set out to explore how environmental data can be reactivated to express matters of concern, rather than a matters of fact. We elaborated on these concepts from Latour and their relation to the field of HCI and design, and aligned our work with existing design and arts-based research projects. Our work stems from a research through design project with air quality data and we maintained the focus on design and design practice throughout this pictorial. We described our work with the air quality lens and used different stages in the process to reflect on the role of ambiguity when working with environmental data. These reflections were synthesised in three design aspects – transposing, layering and materializing – that could inspire and guide fellow practitioners engaging with the topic of environmental data.

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