Airpocalypse

Cycling as a performative art methodology for investigating air pollution.

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This article describes an ongoing practice-based research project in which I am using cycling as a performative method to research air quality, working in collaboration with atmospheric scientists at the University of York. From 6 to 8 August 2020 I cycled Coast-to-Coast from Morecambe, Lancashire to Bridlington, East Riding of Yorkshire as a three-day research art performance (fig. 1).

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During Coast-to-Coast, I considered: How does one visually represent what it feels like to experience poor or adequate air quality while cycling? How can this data and the artwork created be aesthetically understandable to an audience? By focusing on the visual as a form of research I explore photography, mapping, smog swatches, collage techniques and physical swab samples (fig. 5) to begin to create a new visual language for air pollution. These initial methods highlight the exciting challenge of making the invisible visible and the immaterial physical. To give context to this work, in 2020 I also collected air pollution data from cycling journeys throughout the city of York and North Yorkshire. This was to discover and record information on atmospheric pollutants and the effects of damaging air as well as take notes, photographs and swab samples taken from the bicycle. My ongoing practice-based research seeks to uncover alternative ways of evidencing air pollution using a bicycle as a tool for performative journeys. This Coast-to-Coast performance was a calculated progression for my research.

During Coast-to-Coast I wore a 3M 8833 filter mask while simultaneously collecting live pollutant data from the air via a sensor attached to the bicycle. This sensor measures live readings of particulate matter (PM) across three different sizes -- 10, 2.5 and 1 μm; nitrogen dioxide (NO_2); and volatile organic compounds (VOCs). PM consists of tiny particles suspended in the air and sources include transportation, agriculture, manufacturing and secondary processes. ‘PM is considered to be the most dangerous air pollutant and causes the most damage to our health, with the ultra-fine PM_1 shown to bind to blood vessels' (Smedley 2019: 71). To give an idea of the size, PM_{10} is any particle measuring 10 micrometres in diameter or below and often assimilated roughly to a tenth of the width of a human hair. From this, you can gather the invisible characteristics of not only PM_{10} but also the dangerous risks of $PM_{2.5}$ and PM_1. The second pollutant monitored was NO_2, which is a suffocating and irritating gas and can be recognized due to its reddish-brown colour. It has a pungent odour, which some describe as like bleach or chlorine. Fifty per cent of NO_2 emissions are due to traffic but can also arise from heating and electricity generation. VOCs are molecules made mainly of carbon and found as gases in the air. VOCs are also present in many household DIY and cleaning products. They are used in a large proportion of aerosol cans, contributing to PM concentrations. Worryingly, they can spread a great distance from their original sources, which are mainly traffic, industry and residential locations. What I am also learning is that primary and secondary air pollutants are caused by a multitude of factors and can be even affected by seasonal weather conditions, geographical locations and our neighbouring countries with whom we can, due to heavy gusts of wind cycles, share polluted air.

There is a significant gap in our knowledge of historical and contemporary interactions with the air. Aesthetically, we tend to think of air pollution as a product of dirty vehicle exhausts and chimneys. In my case, growing up in Teesside on the north-east coast of England normalized a visual landscape of coal-, oil-, gas- and biomass-fired power stations that provided electricity and heat. 'Power stations are often perceived as the cause of industrial air pollution as they emit a substantial amount of carbon dioxide, as well as sulphur dioxide (SO_2), an acid gas which affects human health and vegetation' (Environmental Law 2020). We generally visualize the chugging black smog that seeps into the atmosphere, as depicted historically by J. M. W. Turner in paintings where smog and steam became the 'glorious symbol of industrial supremacy' (Souter 2020), but perhaps fail to recognize the other invisible key distributors of this problem, such as fertilizers, home heating, animal waste, biomass burning, household chemicals such as cleaning products, candles, sprays and diffusers (Rieuwerts 2016: 15). Once we register the latter, air pollution suddenly feels a lot closer to home. In some cases, it is within our homes.

To communicate air pollution, the UK government, academics and scientists use an Air Quality Index (AQI). Other countries have their own AQIs: for example there is a European AQI, a Chinese AQI and one for the United States. The majority of AQIs are linked to local laws and regulations. The equipment that I use in my practice has its own AQI Index devised by the designers who manufacture the sensor. The Plume AQI has seven levels of pollution classifications linked to the exposure limits outlined by the World Health Organization (WHO). Plume Labs have titled these classifications: Low 0--20, Moderate 21--50, High 51--100, Very High 101--150, Excessive 151--200, Extreme 201--250 and Airpocalyse 251+ (Plume Labs 2020). They translate visually as a traffic light system whereby green represents lower levels of pollution through to red and purple, which translate to very high and excessive levels. The higher the numbers recorded, the higher the levels of pollution in the air. The sensor allows air to flow through the device, and the companion app then reveals the recorded levels.

The Coast-to-Coast route is a 272-kilometre stretch on the Way of the Roses across Lancashire and Yorkshire and passes varied landscapes including the Yorkshire Dales, Nidderdale, the Lune Valley and the Yorkshire Wolds. This route was of particular interest due to an abundance of cycle lanes, country lanes and quieter roads where I could measure and experience pollution levels outside of a cityscape environment. With air quality often seen as a 'problem of urban and higher population areas, a lot of research is therefore absent in rural areas' (Gabrys 2017). Cycling over a longer distance allowed me to gather a larger pool of AQI data, photographs, notes and sound recordings. Collecting data along these rural routes, cycle paths and country lanes recognized a gap in knowledge, lacking in current research.

During the performance, I would stop each time that a Moderate, High or Very High (+) level of air pollution was detected by the sensor, take a photograph of the surroundings and record this location onto a map on my iPhone. I also recorded details about the weather, temperature and a description of the ambient smells present in the atmosphere in a notebook. On an evening, before going to sleep, the bicycle was swabbed using Sellotape to remove any environmental matter and inserted into a notebook for safekeeping (fig. 5). In addition, the mask was kept in a sealable bag until I continued to cycle the following day (fig. 4) -- for scientists to analyse post-performance -- and further notes about my experience of bodily

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tiredness, sensations and emotions, and locations were documented. Riding a bicycle for hours on end is an enduring feat. Inevitably, the body tires from pedalling for hours on end, which, in turn, triggers aches and pains. My intake of food and water also had to increase to help maintain energy levels for the duration. The journey was also underpinned by a narrative of pedalling from the Irish Sea to the North Sea, adopting the cycling tradition of dipping the tyres in the water before and after the performance. The bicycle can be considered not only a tool to collect live data but also as an extension of the body that is powered by the performer.

My affinity with cycling nods to a deeper recognition that ‘cyclists and fellow athletes are at particular risk of exposure to air pollution due to the heavier breathing rates which increase when engaging in cardiovascular activities’ (Rieuwerts 2016: 28). We can acknowledge here the embodied subjective nature of this practice-based research enquiry. ‘Cycling is a human-powered activity’ that allows for freedom of movement and the collection of data (O’Neill 2018). The first-hand experience of riding the bicycle relates to Robin Nelson’s statement that ‘shifting epistemologies offer recognition to the practical, embodied and subjective ways of knowing’ that could, in turn, lead to new and interesting insights (Hunter 2014: 407). The concept of cycling as art practice has developed naturally for me after spending a year living on a bicycle while pedalling around the world. It was during this time that I experienced air pollution first-hand in one of the world’s most polluted cities: Kathmandu, in Nepal (Bhattarai 2020). Over the course of six weeks spent in Nepal, I wore a pollution mask and intermittently measured air quality data for interest purposes. After long days of cycling in the heat, the mask was visibly covered in pollutants, dirt and dust, all of which may have otherwise been ingested deep into my lungs. Despite registering the poor air quality and its hazardous effects on health on a daily basis, it wasn’t until I cycled on the north and west coast of Tasmania soon after -- a location renowned for its clean air -- that the disparity came to the forefront of the mind (Cleland et al. 2016). Furthermore, upon returning to England I had a shock realization when conducting research that highlighted areas of the country that do not meet the legal requirements for air quality. Furthermore, Simon Bowens, a clean-air campaigner from Friends of the Earth, states that: ‘It’s unforgivable that across the UK there are nearly 2,000 locations over air quality limits, leaving millions of us breathing dangerously polluted air’ (Friends of the Earth 2020). We know that city air contains potentially harmful pollutants, including nitrogen dioxide and soot-based particulate matter 10, 2.5 and 1 μm but what are the levels in rural areas?

The disparate experiences of air quality prompted me to engage more explicitly with such research questions and with artists who are engaged in similar fields of practice. In the field of performance art, three artists – Simon Starling, Layla Curtis and Francis Alÿs – have pursued similar projects.

In September 2004, Simon Starling crossed the Tabernas Desert in Spain also on a bicycle (Tabernas Desert Run), but one powered by compressed hydrogen (H). The only by-product of the journey was water that was collected into a cylinder on the bicycle and later used by Starling to produce a cactus painting. After the journey, the bicycle and cactus painting were showcased in an art gallery, both positioned within a glass vitrine. This work shares the concept of 'journeying' and collection from the environment. Another key point of reference for my performance is Layla Curtis's web-based project Polar Wandering (2005--6), which recorded a three-month journey that Curtis made from London to Antarctica, her experiences while in Antarctica and upon returning home. Polar Wandering became an interactive drawing that came to life using a personal Global Positioning System (GPS) tracking device. With regular logging of longitudinal and latitudinal data onto a website, the artist's movements created a virtual line drawing embedded with photographs, sound clips, video and text. As Curtis's project progressed, the live GPS drawing developed into a complex data map through which viewers personally explored this multimedia chart of Antarctica. Finally, in Francis Alÿs's The Collector (1990--2), the artist walked a small magnetic dog-like object on wheels through the streets of Mexico City, picking up pieces of metal from the land as he went. The work explores themes of urbanity via the simple action of walking and strolls.

Some similarities can be identified in the action of cycling and gathering data from the environment. The selected artists' works are all grounded by the idea of journeying, reflecting the artists' movements across the land. However, there are also key differences between their work and mine. For example, Alÿs collected visible metallic bits and pieces from the ground, whereas I am gathering, in most cases, invisible information from the air. Like fellow conceptual performance artists Tehching Hsieh and On Kawara, who have performed strict time-based endurance work, I too adopt a predetermined set of rules that are applied during the performance (O'Neill 2018). Significantly, this approach has defined and reframed a somewhat leisurely bicycle ride as an intentional performance art piece. I am actively premeditating a 'created event', but one that can exist within everyday life: a 'pre-mediated journey', if you like, that is knowingly 'put on' (O'Neill 2008: 57). James Peacock, who writes extensively on the subject of performance states, 'this is not to say that performance is more important than the mundane happenings in life, but to recognise that it is a deliberate effort to represent, to say something about something' (MagdalinskiI 2008: 57). Like mine, these performances are communicative and help to transfer knowledge and disseminate thoughts, sensations and emotions to an audience. In my case, that audience consists of both the cycling community and the wider public.

The duration of the Coast-to-Coast performance was determined by how often I had to stop and record air pollution. The final duration was a total of eighteen hours and fourteen minutes over the course of three days. During the performance, I stopped, recorded and photographed a total of eighty-five points of Moderate, High or Very High levels of air pollution. These location points were recorded on cycle paths, traffic-free paths, country lanes and roads as well as when passing through towns and villages. The highest recordings during the performance were as follows: VOC 43 (Moderate) recorded on 6 August at 14:00 in Church Street, Settle; PM_{10} 142 (Very High, fig. 2) recorded on 7 August at 09:20 on the B6265 in the Yorkshire Dales; $PM_{2.5}$ 30 (Moderate) recorded on 7 August at 09:55 on the B6265 in the Yorkshire Dales; PM_1 11 (Low) also recorded on 7 August at 09:56 on the B6265 in the Yorkshire Dales; and NO_2 66 (High) recorded on 8 August at 09:43 on Scoreby Lane, Catton, East Riding of Yorkshire.

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Once back at the studio, I developed a colour swatch from each of the 272 photographs I had taken, documenting eighty-five recorded areas in order of capture time, and created a swatch chart and additional GIF (fig. 3). I experimented with how to create an abstract visualization of information taken from the data I collected evidencing air pollution levels of Moderate and above. These studio experiments were disseminated on Instagram in the first instance, to share knowledge of the data gathered on a user-friendly social platform that can reach the wider public and cycling community. I also uploaded and presented an image of the Sellotape swatches that were swabbed from the bicycle each day (fig. 5). I then collaborated with atmospheric scientists Daniel Bryant and Sri Hapsari Budisulistiorini at the Wolfson Atmospheric Chemistry Laboratories (WACL), University of York, to analyse the environmental matter collected on the mask and discuss further potential methods of collection (fig. 1, fig. 4).

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For the laboratory to be able to test the mask that I wore during the performance, the scientists and I needed to calculate how much air was breathed in during the work and also, crucially, test an unused 3M 8833 mask alongside the one that I had worn. This was to ensure that any air pollutants detected were collected during the performance itself and not during the mask's manufacturing process.

Figure 5 highlights the differences between the two masks during testing. The used mask produced a cloudy, dirty solution that evidenced that some forms of pollutants were present. The comprehensive process of testing the mask in the laboratory is explicated in the Appendix. What was interesting about the results of this process was the inevitable impact that the body had on the sample collection. The body's natural oils and perspiration, as well as suntan lotion, were all present in the comprehensive analysis results and were the cause of the cloudy solution contamination. The comparative lack of pollution detected in the final analysis, despite pollution levels registering in the air at the time of the ride, could have been for a number of reasons. The mask was not tested immediately after the performance due to COVID-19 restrictions and I did not keep the mask at a low enough temperature to help maximize recovery of environmental data.

The scientific procedures and knowledge in order to test the mask promote the idea of the laboratory now becoming an artist studio as well as a space for interdisciplinary dialogue. To elaborate, throughout the process of testing, the scientists and I fostered ideas for improved and targeted modes of collection that can be attached to the bicycle in my next performance ride. A sampler apparatus will now be connected to the bicycle to help more targeted analysis. This piece of equipment essentially pumps air through filters that capture PM_{10} from the environment. Engaging in such interdisciplinary practice is crucial for my ongoing research, which asks what art can contribute to research in air quality. Collaboration fosters creativity and can promote a science-art hybridity and uniqueness to this field of research. I seek to expand the scope of existing academic enquiry and generate new insights by researching pollution from a visual, creative, practice-based standpoint. This is a viable approach to raising awareness and improving individual knowledge about air pollution that will help reduce personal exposure and investigate alternative ways of generating evidence.

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Based on the data actively captured from rural areas during Coast-to-Coast, pollution levels in these locations are surprisingly high. The highest PM_{10} recording was 142 (Very High) in the Yorkshire Dales, a location surrounded by fields and beautiful vistas (fig. 2). This data evidences that air pollution is not just a problem for big cities but that dirty air can also be present in the places where we least expect it. ‘Unacceptably toxic air can be found across much of the UK, even in smaller towns. It is harming the health of people across the country and is especially bad for young children whose lungs are still developing’ (Harvey and McIntyre 2019). ‘Official’ statistics and figures aside, an individual’s experience of air pollution is arguably just as valuable as data taken from fixed monitoring stations, which oddly, are often placed away from roadsides and some, rather pointlessly, over 4 metres in the air, well above human breathing height. Environmental monitoring practices are not just ways of documenting the presence of pollutants but also offer additional techniques for ‘tuning sensation and feeling the environment through different experiential registers’ (Gabrys 2017). With this in mind, I can consider further my bodily interactions, experiences and lived encounters while cycling. How does pollution move through bodies, the bicycle and environments? My notebook of listed smells documented during Coast-to-Coast helps to provide more insight into the embodied experience of gathering data of air pollution. I can emphasize that I am contributing to scientific research of this problem by my use of performative methods, in particular the centrality of my body, which is usually excluded from scientific research. Our bodies are within the environment, we are affected by the weather, as vessels we smell, feel and touch our surroundings.

There is an obvious and very clear need to further increase public awareness of air pollution and update our visual cues from chimneys and power stations. My practice seeks to contribute to this new aesthetic by offering insights from the collection of physical matter and informative art that can engage the viewer emotionally and physically, not just mentally. Insights conveyed through this performance, including imagery and metaphor, contribute to the development and implementation of personal action by communicating in ways that have not been previously employed by science. I have considered the new knowledge element of researching pollution from a visual, creative, practice-based perspective and perhaps a speculative approach that may bring forth artwork that is more accessible to the wider public. By monitoring their surroundings, individual members of the public can develop a deeper connection with and understanding of their direct environment. In turn, my work can help inform the public of their immediate risk, and allow them to become more aware of their surroundings and the experience of being in polluted areas, rather than just being faced with the stagnant statistics. The public can own the knowledge of their day-to-day exposure, from the commutes that they make, to the routine walks or cycle rides that they enjoy, or even the air pollution levels when they drop their children off at school.

My experiments with making art about experiencing air pollution while cycling are ongoing, and perhaps an interest in 'liveness', the notion of broadcasting and the interface will develop the methods used to disseminate the work more successfully. A more immediate connection to the wider public is key, one that enables expanded forms of experience and awareness. Continuing with Instagram as a visual platform, in the first instance, is interesting due to the levels of engagement the work has already received. Audiences are regularly sharing similar experiences regarding air pollution, pinpointing specific locations, attributing factors, smells, memories and emotions. This dialogue provides further insight and may help others question their own exposure. Moreover, sourcing additional equipment that I can attach to the bicycle to trap air pollutants more effectively is ongoing and informed by scientists at

(WACL). This interdisciplinary dialogue builds upon, shapes and informs key elements of my continuing creative practice. As bodies we ‘leak’, as I did onto the mask that I wore. Ultimately it is difficult to entirely separate the body, and the space that it occupies, from the air that it breathes and moves within -- we are intertwined, interconnected. It remains easy to forget about this invisible element that pervades every aspect of our lives. My cycling performative art research helps to remind us.

Appendix

The mask was extracted and analysed through an established method used for $PM_{2.5}$ filter samples, using liquid chromatography--mass spectrometry to identify compounds captured on the mask. The masks were first prepared for extraction by the removal of the elastic cord, the soft plastic that seals the mask to the user’s face and the valve. The mask was then cut up into pieces and submerged in methanol (optima, LC-MS grade, ThermoFisher Scientific) and sonicated for forty-five minutes. Next, the liquid extract was filtered through a 0.22-μm filter, into 20 ml vials each containing ~10 ml of extract. The extracts were then evaporated to a reduced volume, combined and evaporated to dryness. Finally, the dry extract was reconstituted into 90:10 methanol:water (optima, LC-MS grade, ThermoFisher Scientific) and filtered again through a 0.22-μm filter. The samples were analysed using ultra-performance liquid chromatography (UPLC)-full scan-ddMS^2, involving an Ultimate 3000 UPLC (Thermo Scientific, USA) coupled to a Q-exactive Orbitrap MS (Thermo Fisher Scientific, USA) with a heated electrospray ionisation (HESI). The UPLC method uses a reverse phase, 2.6 um, 100 x 2.1 mm, Accucore column (Thermo Scientific, UK), held at 40 ºC. The mobile phase consists of LC-MS grade H_2O and 100% MeOH, both acidified with 0.1% formic acid to improve peak resolution. The injection volume was 4 uL. The solvent gradient was held for one minute at 90:10 H_2O:MeOH, then changed linearly to 10:90 over twenty-four minutes, returned to 90:10 over two minutes and then held for two minutes, with a flow rate of 300 ul min^{-1}. The MS was operated in negative mode, using full scan ddMS^2. The scan range was set between 50 and 750 mz, with a resolution of 120,000. The capillary and auxiliary gas temperatures were 320 ºC. The number of most abundant precursors for MS^2 fragmentation was set to 10. Compound discover (version 2.1, ThermoFisher Scientific) was used to identify compounds using set parameters.

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