Sensory maps

McLean, K.

Sensory Mapping

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Glossary

Cross-modal

perception that involves interaction between two or more sensory modalities

Smellscape

the olfactory equivalent of a landscape accommodating both episodic (foregrounded or time limited) and involuntary (background) odors

Soundscape

an acoustic environment that can be perceived by human, both natural and artificial

~~Synaesthesia~~Synesthesia

a perceptual phenomenon whereby stimulation of one sensory pathway leads to involuntary stimulation of a secondary pathway

In “De Anima” (On the Soul) Aristotle first proposed that humans have five senses: vision, touch, smell, sound, taste. Human senses, broadly defined as the physiological capacity of organisms that provides data for perception, number anywhere between 22 and 33 to include five active senses and various sub-categories such as proprioception, ~~kinaesthesia~~kinesthesia, and thermoception. There are many instances of sensory crossovers; ~~synaesthesia~~ synesthesia is a neurological condition in which stimulation of one sensory modality causes unusual experiences in another unstimulated modality, whereas cross-modal studies propose and investigate deliberate connections between sensory stimuli. We sense a place by combining sensory information across all our senses, and the particular form of sensory hierarchy is mediated by the activity in which we are engaged. This article covers maps based on Aristotle’s original five senses, opening opportunities for future cartographies of wider-ranging sensory stimuli through new output media combinations (Fig. 1).

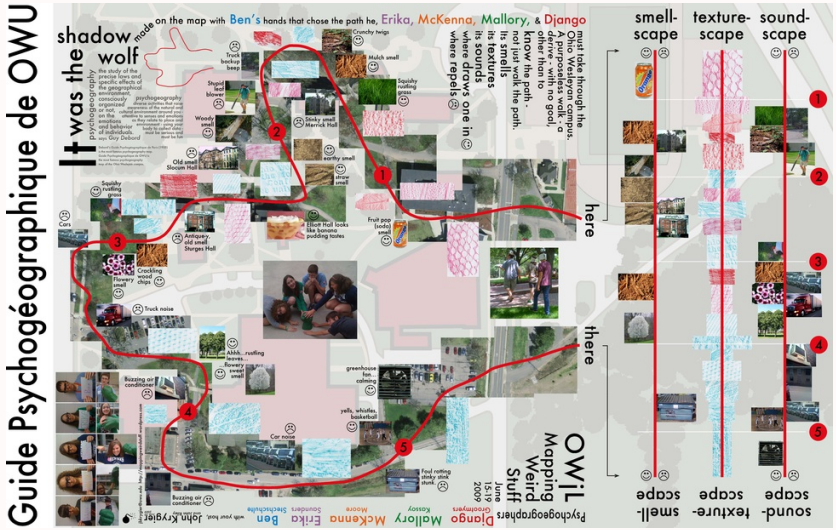


Figure 1 Guide Psychogéographique de OWU led by John Krygier 2009

Single-sense maps focus attention on the representation of one of sound, smell, taste, or touch; however, representation of sensory findings are not always in the medium of original encounter with each sense having its own cartographic imperative and history. Currently sound and smell have many more practitioners than do touch and taste. The maps featured are few from a field of hundreds of practitioners. In addition to maps of our sensed experience of the world, sensory maps may also convey datasets such as gunshots and air quality.

Smellmapping

Where Eastern olfactory mappings took the form of oral histories, one of the earliest surviving cited Western (written) smellmaps was generated in February 1790 when Paris's chair of public hygiene, Jean-Noel Hallé, and his assistant undertook a smellwalk along the Seine from Pont Neuf to the sewer of Saltpêtrière and back. Noting wind, temperature, and river height the resulting "map" contains nothing but odors, detailing olfactory information with reference to the quays as geographic locations. Hallé cites odors of toxic and noxious industrial practices as well as simply unpleasant emanations from the sewage in the river highlighting fundamental differences that can be gleaned from olfactory information. As 19~~nineteen~~th ~~e~~Century European cities became more crowded, sewage systems struggled to cope, and smells were widely believed to be the carriers of disease. Resulting olfactory cartographies, such as Hector Gavin's 1848 *Pestilent Disease Mist of Bethnal Green,* epitomize the airborne paranoia of smells as carriers of disease and pestilence deploying a visual brown stain indicating stagnant air overlaying sections of the street map printed underneath. The underlying message was "enter this zone at your own risk." In 1870, the Manhattan Board of Health officials sniffed the air to determine where the malodors~~malodours~~ of offensive trades (odor-producing industries such as slaughter-houses, oil refineries, gas works, phosphate works and manure heaps) could be detected. Such "miasmas" are discussed by Foucault's lectures on "Security, Territory, and Population" and remain on-going concerns of contemporary urban design and planning. The visualization, *Map Showing Location of Odor Producing Industries of New York and Brooklyn*, uses a simple arrow to indicate the spatial displacement of odor from source to site of detection with diagonal hatching as a visual warning as to spatial "no-go zones." Historical smellmaps have been replotted enabling a direct comparison with the smells of the past with current knowledge, layering past and present as seen in Matthew Frank's rendering of the 1910 Manhattan Metropolitan Sewerage Commission report whose use of digital cartographic pushpin shadows to indicate underground smells distances the viewer, and poses questions as to how to imagine the smells as experienced (especially with banana oil, which was used as a paint thinner in the day, but is now an unfamiliar odor).

The above examples are forerunners to current on-line odor monitoring maps created by environmental emissions detection agencies within a positivist paradigm designed to regulate smell emission and to rationalize risk. While there are relatively few regular practitioners of contemporary olfactory cartography, many take on the challenge for one-off research projects resulting in a wide range of aesthetic decisions and art and design outcomes as well as odor and particulate models that approximate smell diffusion. Smellmaps output in the form of sniffable smells require a physical presence; galleries have commissioned works that illustrate and explore their cities or neighborhoods or enable distant places to be explored through the nose.

Smell, O~~o~~utput as S~~s~~mell

City smellscape maps output through smell range from the highly conceptual to the ultra-realistic, offering a chance to sniff selected and summarized aspects of the city in question. Sissel Tolaas has completed 52 city smell projects since 1998, including *NoSoEaWe Berlin* (2004) and *Talking Noses: Mexico City* (2001–2009). The focus is on "permanent" local smells, and the work is designed to challenge olfactory prejudices and intolerances of a cit~~ies~~'s' inhabitants. Tolaas deploys electronic nose air-sampling technologies, followed by chemical analyses and synthetic replication of odor molecules. The smells dissemination methods vary from installation exhibitions featuring bottled scents to embedded sculptures, bespoke perfume bottles to scratch-n-sniff walls. "Scratch-n-sniff, "a method of printing with synthetically-produced odor molecules generates tactile surfaces that "release" the odor when rubbed, was also adopted by Nicola Twilley for "You Are Here," a psychogeography installation at the Pratt Manhattan Gallery in 2010. *Scratch 'N Sniff NYC* (Fig. 2). The exhibited works demonstrated research into dominant odor perception in NYC neighborhoods. A second, scratch-n-sniff sticker map challenged the usual "what" of smell, drawing instead on research about "how" New Yorkers smell, drawing the highly-personal (genetic- and preference-based smell perceptions) into the map.

Figure 2 Scratch 'N Sniff NYC by Nicola Twilley. Photo © Andreas Keller 2010

Communicating olfactory geographical need not be static, as Brian Goeltzenleuchter's *Sillage* series of neighborhood city smellscapes (Fig. 3) demonstrates as humans wear their neighborhood's smell and move around a room emulating the dispersing nature of smells themselves.

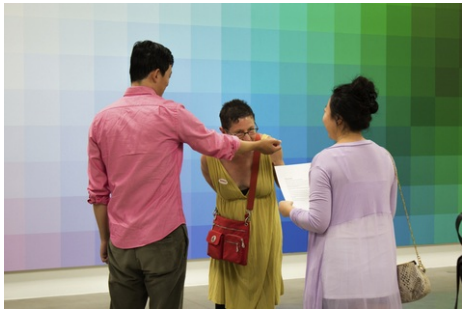


Figure 3 Sillage: Los Angeles (Santa Monica Museum of Art Patron Demographic Profile), olfactory artwork launched at the Santa Monica Museum of Art, 2014 ©Brian Goeltzenleuchter

Smell, Ooutput in Ttactile Fform

A mapping that physicalizes experiential aspects of smell perception draws on cross-modal theories to connect smell and touch. Investigations by a group of French design students proffered a series of options for rendering olfactory experience as tangible. Mapping using the materiality of original smell sources reveals significant areas of smell voids, and also the places where smells overlap (Fig. 4).

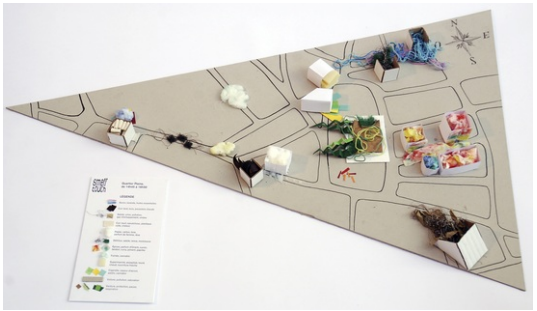


Figure 4 Marseille Smellmap 4 o'clock segment by DSAA1 lycée Jean Perrin Design Studies students. Photo by Alexandre Licata

Datascaping, a practice used by architects to realize data-driven models, is a branch of data visualization depicting invisible quantitative data as it intersects with contextual spatial information creating topological structures. Examples in this category ~~(Fig. 5)~~ indicate phenomenological relationships between the intensity and the perceiver of the smells revealing neighborhoods of greater and lesser olfactory complexity. And the seeming weightlessness of smell is depicted as a delicate, fragile mesh of smell intersections (Fig.5) ~~(Fig. 8)~~. As smellscape renderings become increasingly abstract, 3D creative mappings are used to pose questions as to what it would be like if human noses could see smells interacting.

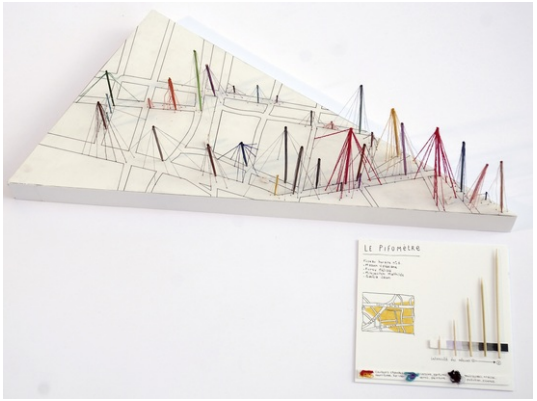


Figure 5 Marseille Smellmap 6 o'clock segment by DSAA1 lycée Jean Perrin Design Studies students. Photo by Alexandre Licata

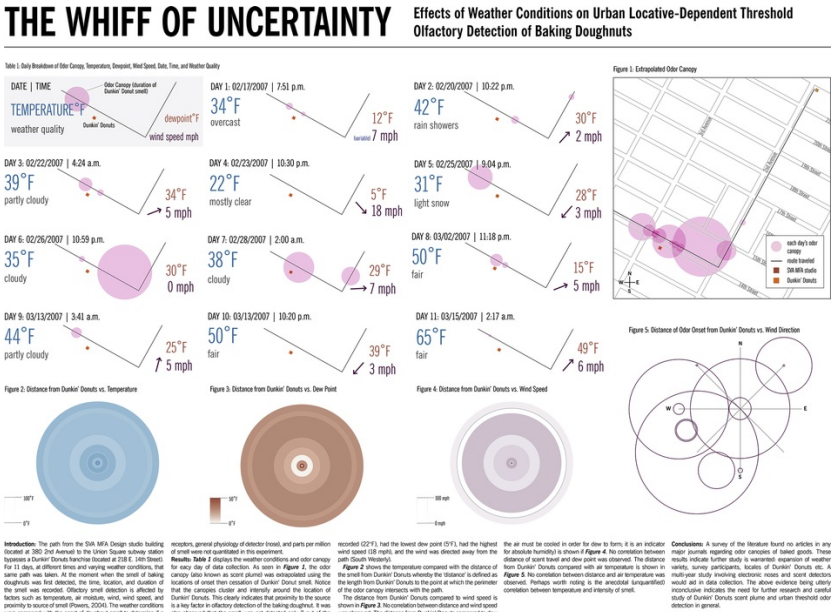


Figure 6 Whiff of Uncertainty © Esther Wu 2007

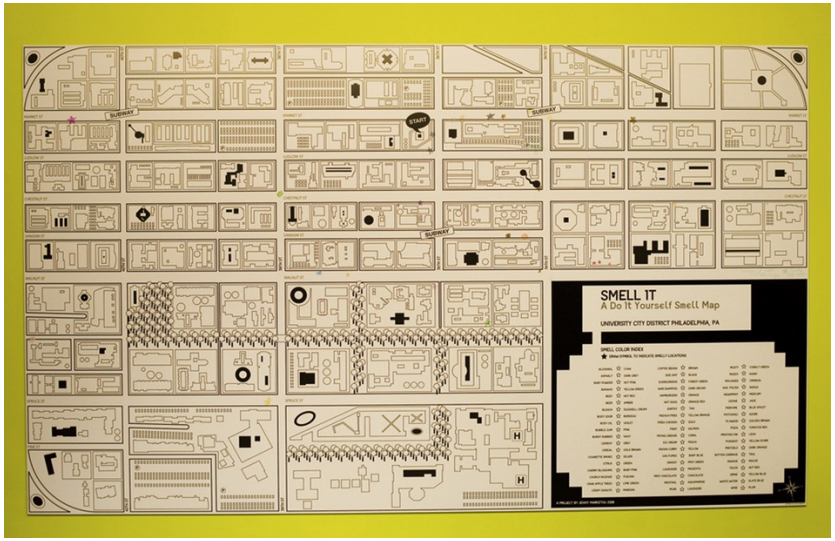


Figure 7 Smell It. A Do It Yourself Smellmap by Jenny Marketou 2008. Image courtesy of Monell Center

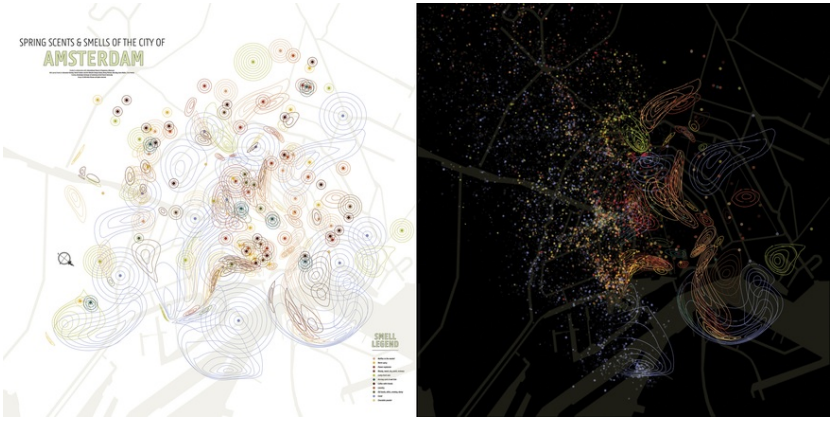


Figure 8 Smellmap: Amsterdam © Kate Mclean 2014

Smell, Ooutput as dDigital

The digital mash-up was a common approach in the early 2000s, however it has poor longevity; the *Japanese Smell Club* (Nioibu), Gawker's *New York subway smellmap*, Avery Gilbert's *Smell of Dead People* and Matthew Frank's *1910 New York Sewer Map* are no longer available online although the *Daily Chicago Chocolate Smell Map* retains a presence, as does the *Olfactory Factory*. An alternative digital environment to address and explore the temporal, ephemeral nature of smell and its evanescent, volatile qualities is mapping through animation as explored in Kate McLean's doctoral research.

Smell, Ooutput as 2D Vvisual

Traditional printed 2D maps are tools for artists and designers to explore aspects of olfactory perception using data collected by an individual or by many. From a graphic design perspective, Esther Wu recorded smells of baking donuts (Fig. 6) over 11 ~~eleven~~ days on one specific street corner, factors in changing weather in the quest for a pattern of odor duration and location.

Jenny Marketou's *Smell It Do It Yourself Smell Map* (Fig. 7) encouraged visitors to the Esther Klein gallery in Philadelphia to walk, sniff, and return to visualize their findings. This type of mapping challenges contemporary odor-phobic perceptions and the stigmas

of deliberate sniffing in public, with the aim of charting the subjective importance of scent in urban landscapes.

In addition to localized identification of odors, smellmaps also indicate their dimensionality and complexity, alluding to the lived experience of sniffing within a smellscape. Designed to give a visual form to an invisible sensory landscape, McLean's smellmaps of Edinburgh (2011), Newport (2012), Amsterdam (2013), Kyiv (2016) make us of a modified conventional cartographic symbol (Fig. 8) to indicate how smells disperse across a city. Contours show the smells' range and their movement as propelled through air by prevailing winds, delineating airspace rather than anchored ground. Unlike standard isopleths, which cannot cross, smell-isopleths overlap, indicating the impossibility of accurately, objectively mapping smell. An alternative approach, that replaces contours with dots as smell symbols, represents smellscapes in which humidity has a greater influence on the airborne smellscape than does the wind.

Instrumentalized within landscape design, urban design and planning and architecture; smellmapping enables analysis of hedonic tone of olfactory experience for example the Smell Map of Gowanus (Fig. 9), and as a tool for the comparative study of inter-modal transit spaces.

Figure 9 Gowanus Smell Map © Annie Barrett Studio 2016

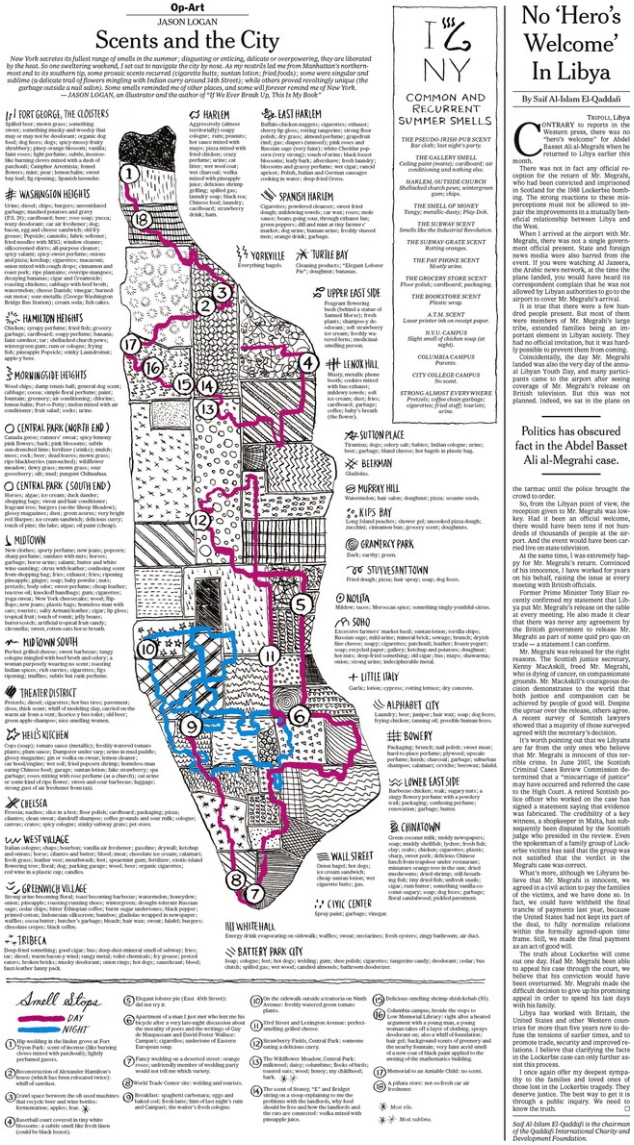
Smellmapping is equally deployed for editorial content and as a research tool; Jason Logan's illustrated route map *Scents and the City* (Fig. 10) extracts notable smell encounters from a weekend walk through the length of Manhattan and Natalie Bouchard's text overlay onto a Google Earth base map (Fig. 11) communicates a collective olfactory memory as part of a study into the power of smells to shape spatiotemporal perceptions of the environment.

Op-Art

JASON LOGAN

Scents and the City

New York secretes its fullest range of smells in the summer; disgusting or enticing, delicate or overpowering, they are liberated by the heat. So one sweltering weekend, I set out to navigate the city by nose. As my nostrils led me from Manhattan's northernmost end to its southern tip, some prosaic scents recurred (cigarette butts; suntan lotion; fried foods); some were singular and sublime (a delicate trail of flowers mingling with Indian curry around 14th Street); while others proved revoltingly unique (the garbage outside a nail salon). Some smells reminded me of other places, and some will forever remind me of New York.
— JASON LOGAN, an illustrator and the author of "If We Ever Brush Up, This Is My Book"



I ♥ NY

COMMON AND RECURRENT SUMMER SMELLS

THE PSEUDO-IRISH PUB SCENT
Bar cloth; last night's party.

THE GALLERY SMELL
Ceiling paint (matte); cardboard; air conditioning and nothing else.

HARLEM OUTSIDE CHURCH
Shellacked church pews; wintergreen gum; chips.

THE SMELL OF MONEY
Tangy; metallic-dusty; Play-Doh.

THE SUBWAY SCENT
Smells like the Industrial Revolution.

THE SUBWAY-GRATE SCENT
Rotting oranges.

THE PAY PHONE SCENT
Mostly urine.

THE GROCERY STORE SCENT
Floor polish; cardboard; packaging.

THE BOOKSTORE SCENT
Plastic wrap.

A.T.M. SCENT
Laser printer ink on receipt paper.

NYU CAMPUS
Slight smell of chicken soup (at night).

COLUMBIA CAMPUS
Parents.

CITY COLLEGE CAMPUS
No scent.

STRONG ALMOST EVERYWHERE
Pretzels; coffee chain garbage; cigarettes; fried stuff; tourists; urine.

No 'Hero's Welcome' In Libya

By Saif Al-Islam El-Qaddafi

TRIPOLI, Libya

CONTRARY to reports in the Western press, there was no "hero's welcome" for Abdel Basset Ali al-Megrahi when he returned to Libya earlier this month.

There was not in fact any official reception for the return of Mr. Megrahi, who had been convicted and imprisoned in Scotland for the 1988 Lockerbie bombing. The strong reactions to these misperceptions must not be allowed to impair the improvements in a mutually beneficial relationship between Libya and the West.

When I arrived at the airport with Mr. Megrahi, there was not a single government official present. State and foreign news media were also barred from the event. If you were watching Al Jazeera, the Arabic news network, at the time the plane landed, you would have heard its correspondent complain that he was not allowed by Libyan authorities to go to the airport to cover Mr. Megrahi's arrival.

It is true that there were a few hundred people present. But most of them were members of Mr. Megrahi's large tribe, extended families being an important element in Libyan society. They had no official invitation, but it was hardly possible to prevent them from coming.

Coincidentally, the day Mr. Megrahi landed was also the very day of the annual Libyan Youth Day, and many participants came to the airport after seeing coverage of Mr. Megrahi's release on British television. But this was not planned. Indeed, we sat in the plane on the tarmac until the police brought the crowd to order.

> Politics has obscured fact in the Abdel Basset Ali al-Megrahi case.

So, from the Libyan point of view, the reception given to Mr. Megrahi was low-key. Had it been an official welcome, there would have been tens if not hundreds of thousands of people at the airport. And the event would have been carried live on state television.

At the same time, I was extremely happy for Mr. Megrahi's return. Convinced of his innocence, I have worked for years on his behalf, raising the issue at every meeting with British officials.

Former Prime Minister Tony Blair recently confirmed my statement that Libya put Mr. Megrahi's release on the table at every meeting. He also made it clear that there was never any agreement by the British government to release Mr. Megrahi as part of some quid pro quo on trade — a statement I can confirm.

Mr. Megrahi was released for the right reasons. The Scottish justice secretary, Kenny MacAskill, freed Mr. Megrahi, who is dying of cancer, on compassionate grounds. Mr. MacAskill's courageous decision demonstrates to the world that both justice and compassion can be achieved by people of good will. Despite the uproar over the release, others agree. A recent survey of Scottish lawyers showed that a majority of those surveyed agreed with the secretary's decision.

It's worth pointing out that we Libyans are far from the only ones who believe that Mr. Megrahi is innocent of this terrible crime. In June 2007, the Scottish Criminal Cases Review Commission determined that a "miscarriage of justice" may have occurred and referred the case to the High Court. A retired Scottish police officer who worked on the case has signed a statement saying that evidence was fabricated. The credibility of a key witness, a shopkeeper in Malta, has subsequently been disputed by the Scottish judge who presided in the review. Even the spokesman of a family group of Lockerbie victims has said that the group was not satisfied that the verdict in the Megrahi case was correct.

What's more, although we Libyans believe that Mr. Megrahi is innocent, we agreed in a civil action to pay the families of the victims, and we have done so. In fact, we could have withheld the final tranche of payments last year, because the United States had not kept its part of the deal, to fully normalize relations within the formally agreed-upon time frame. Still, we made the final payment as an act of good will.

The truth about Lockerbie will come out one day. Had Mr. Megrahi been able to appeal his case through the court, we believe that his conviction would have been overturned. Mr. Megrahi made the difficult decision to give up his promising appeal in order to spend his last days with his family.

Libya has worked with Britain, the United States and other Western countries for more than five years now to defuse the tensions of earlier times, and to promote trade, security and improved relations. I believe that clarifying the facts in the Lockerbie case can only further assist this process.

I once again offer my deepest sympathy to the families and loved ones of those lost in the Lockerbie tragedy. They deserve justice. The best way to get it is through a public inquiry. We need to know the truth. □

Saif Al-Islam El-Qaddafi is the chairman of the Qaddafi International Charity and Development Foundation.

Figure 10 Scents and the City © Jason Logan 2009

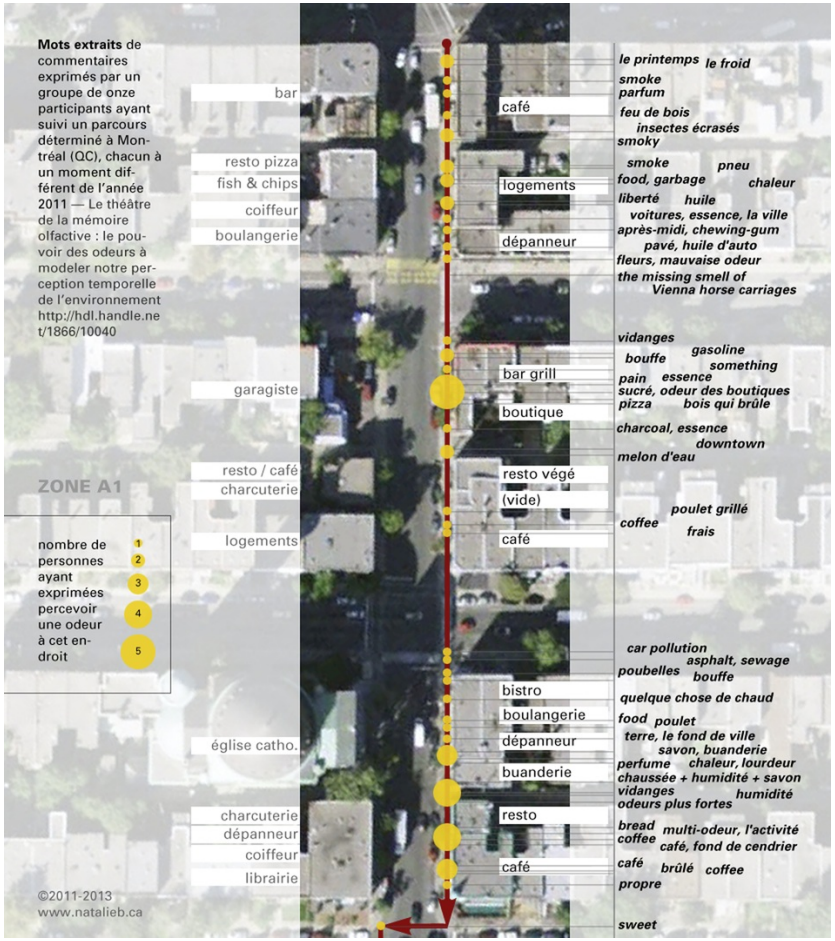


Figure 11 Commented smellwalk © Natalie Bouchard 2011

Air quality, odor monitoring, and pollution mapping may also be regarded as a form of smellmapping. Urban observatories collect air samples using electronic noses and subsequently perform air quality analysis using a sensor matrix in combination with meteorological data. There are two major uses of such technology and subsequent mappings; odor plume mapping to inform containment of industrial production and/or waste management, and particulate matter monitoring at local levels to examine clean air and mitigate local exposure for improved public health.

Smell, Mmapped Tthrough Wwalking

Here smellmapping is regarded as an active practice in the form of a walk to expose participants to a performative and relational sense of place through olfaction. Used across disciplines from olfactory art, urban design and communication design practitioners a smellwalk might involve smell detection and/or smell identification and may be conducted one-to-one, in pairs, or in groups. Blindfolds are occasionally used to divert attention away from the influence of sight on smell (Fig. 12).

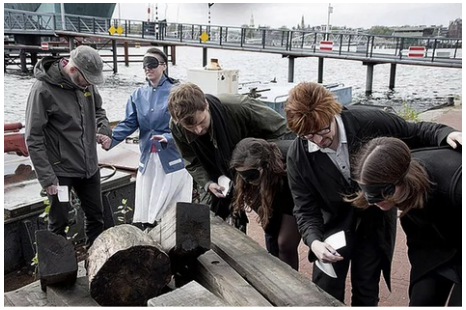


Figure 12 The Scent of Amsterdam (workshop) Workshop & Walk led by Klara Ravat. Photograph by Chiara Barraco, courtesy of Mediamatic

Taste Mapsu

Taste maps abound within tourism; artists and illustrators are regularly commissioned to create bespoke works to lend gastronomic atmospheres to countries, cities, and neighborhoods. A vast range of food and drink maps found online depict ingredients, finished dishes, kitchen utensils all intermingled with local landmarks set in a physical location. Beverage industries also make use of the map to demonstrate their terroir and explain the names by which their products are known. Examples of such work can be easily found online through artists, tourist boards, and specialist interest groups such as the beverage industries. For example, Rosie Mackean's photo food maps of Greece (Fig. 13), Italy, and Spain highlight locally-grown and sourced foodstuffs in each of these countries.

Figure 13 Food Map: Greece © Rosie Mackean stylist/creator 2017. Photography: Gemma Bringloe

In contrast, McLean's taste map of Edinburgh represents the fat intake of an exaggerated Scottish diet. The 3D elevation map (Fig. 14) carved from beef dripping fat forms an elevation map to show cumulative fat calories ingested over a day. Architectural figures reinforce the notion of how a mountain of fat is climbed by the body, on a daily basis. Also serving as urban commentary, maps made from Jell-O allude to the passing of time and the nature of urban growth, as created by artist Liz Hickock.

Figure 14 Taste Map: Edinburgh © Kate McLean 2011

There are many edible maps available as commercial products, artworks, and as teaching resources; Hargreaves and Levin's playful series of countries depicted in a representative food take a design approach to the layout and communication of place. In contrast to such playfulness, the "Edible Map" project seeks to locate land in urban neighborhoods where food might be grown. A bespoke, data-driven methodological framework of walking and talking, in conjunction with a site-specific visualization tool, creates future vision for localized urban agriculture.

Soundmaps

Evolution of the Soundmap

The mapping of soundscapes was first practiced in 1929 by Finnish geographer, Granö, who qualitatively recorded time and frequency of natural and artificial sounds. Once a tool for urbanists, the sound map has developed into an interdisciplinary new media practice. Contemporary, mainly digital, soundmaps cover urban and rural environments, with themes covering memory, cultural and biological diversity, everyday environments, and music preferences. The spectrum of research agendas includes and combines the creative, the ecological, and the political. Sound mapping is sometimes referred to as *cartophony*—a hybrid of the cartographic and the sonic.

Sound, Ooutput as Vvisual

In 1967 Michael Southworth's MIT Masters thesis entitled *The Sonic Environment of Cities* investigated the perceptual form of the soundscape, visible activity and spatial form. The study of two specific Boston neighborhoods, Beacon Hill and India Wharf, resulted in iconic and visually stunning cartographic blueprints of the experienced soundscape. *Sound Types* include "water flowing" and "distant roar." *Temporal Patterns* indicate "daytime and night-time occurrence" and "change in sound content on Sundays."

The theoretical framework for soundmapping originates in acoustic ecology and soundscapes as R. Murray Schafer and other scholars of the *World Soundscape Project* (WSP), completed initial fieldwork in Vancouver. Schafer's *Isobel Map of Stanley Park* (1974), quantitatively measured sound pressure levels along the park's footpaths at 100-yard intervals, and indicates how sound might be represented using the cartographic convention of the isopleth to join similar decibel points to reveal the quiet spaces away from road networks. The WSP continued their work with a comparative study of *Five Village Soundscapes* in Europe in 1975 resulting in a series of individual visual maps highlighting aspects of the sonic landscape. These maps are pioneering in their mixed methodological approach that recorded sonic patterns of village life using qualitative interviews with locals in combination with the quantitative data of sound recordings, isobel maps, morphology charts, and pitch recordings.

More recently, Simon Elvin's *Silent London* (2005) map used city data about London's noise levels to reveal the silent places showing an alternative side of the city through a visual and tactile output. Acoustic sensors enable sound data to be detected and recorded as mapping facilitates data comparisons over time—examples in this category include the DC gunshot map. An algorithm is used to triangulate noises, and then a human is used to verify the sound is indeed a gunshot—useful information for police officers at the scene of reported incidents. Mobile versions of this type of acoustic sensor are used by the armed forces to determine local gunfire. Sound sensors are also used to map landscapes ranging from the sea floor to internal human organs.

Sound Ooutput as Ttaste/vVisual

The lexical-gustatory synaesthete James Wannerton used the diagrammatic mapping trope of the underground system substituting station names with the tastes he experiences when he hears them to facilitate non-synaesthetes comprehension of his world experience. To date two such maps enable others to gain an insight into how someone else perceives the world; *Tastes of London 1964–2013* and *Toronto Subway ~~Synaesthesia~~ Synesthesia Map*.

Sound, Ooutput as sSound (Nnon-digital)

Simon Elvins *FM Radio Map* (2006) plotted the location of FM commercial and pirate radio stations within London. Power lines, drawn in pencil on the back of the map, conducted electricity from the radio to the front of poster. Placing a metal pushpin onto each station allowed the listener to hear a sound broadcast live from that particular radio station.

Sound, Ooutput as dDigital

Sound can be digitally recorded with ease and digital technologies have enabled the emergence of a range of locative on-line sound maps shifts sound mapping from static and time-fixed 2D cartographic representation to include spatial, temporal, acoustic, and visual elements. Digital practices enable databases and archives of sounds to be maintained and shared worldwide. In the ~~UK~~United Kingdom, the British Library, contains 90,000 selected sound map recordings of music, spoken word, and human and natural environments. There are four main types of digital soundmap: deferred and static telematic sound maps, deferred and dynamic telematic sound maps, static sound maps in real time, dynamic sound maps in real time. (See also quantitative Noise Maps for the cognitive approach.)

Creative online soundmapping both combines and rejects the range of senses. Experimental forms such as *Miastofon* removes all visual references, map or contextual, but requires listeners to activate the sounds through repositioning a cursor over a black screen thus creating an impression of being a blind person navigating Gdansk's urban landscape. Jen Heuson's *Soundscapes of the Black Hills* (Fig. 15) provides extra contextualization of historical landmark locations with imagery and commentary, adding layers to listener experience. Such narrative environments produce maps that emphasize personal association, emotion, and memory.

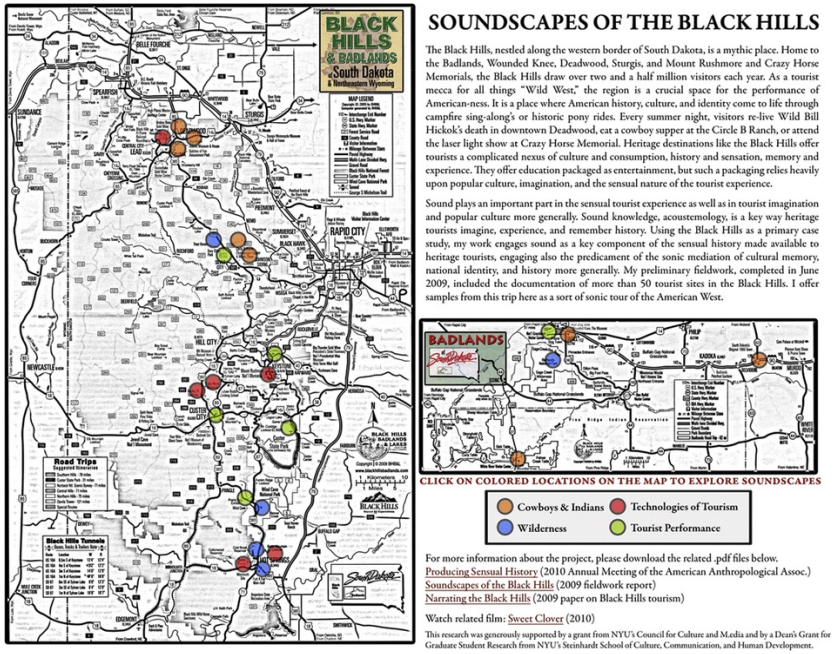


Figure 15 Soundscapes of the Black Hills © Jen Heuson 2009

While wayfinding needs of the visually impaired are primarily addressed through haptic maps, auditory cues can provide navigational and complementary information; Golledge's research deployed sound as one feedback mechanism for non-visual route guidance and more recently sets of detailed audio instructions have been developed and tested in London and Sydney underground transport systems by AbilityNet with the aim of creating a standard set of instructions for app developers and those managing accessibility in public spaces.

Opensource mappings are popular devices enabling thematic approaches to collecting and disseminating themed recorded sounds. Radicchi's deferred and static telematic *Tender Soundmap of Florence* (Fig. 16) investigates possible relations between Florentine soundscapes and emotional dimensions. Perceived by the city's users, local population and tourists places humans at the center of the work as the map is a qualitative tool intended to expand practices of deep listening.

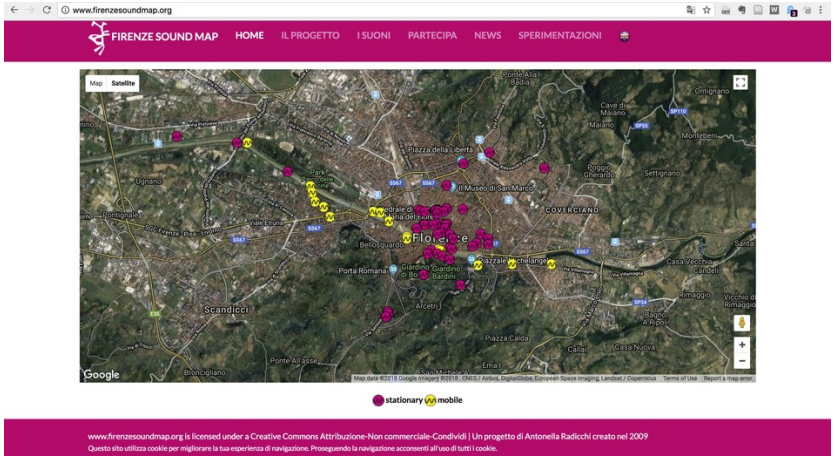


Figure 16 Firenze Sound Map © Antonella Radicchi

Set up to explore the connections between sounds in the environment and their geography *favourite sounds* (Fig. 17) was developed by Peter Cusak from the long-running favorite sound project, which aimed to discover, and celebrate, what people value about the soundscapes of the cities, towns, and neighborhoods where they live and work.

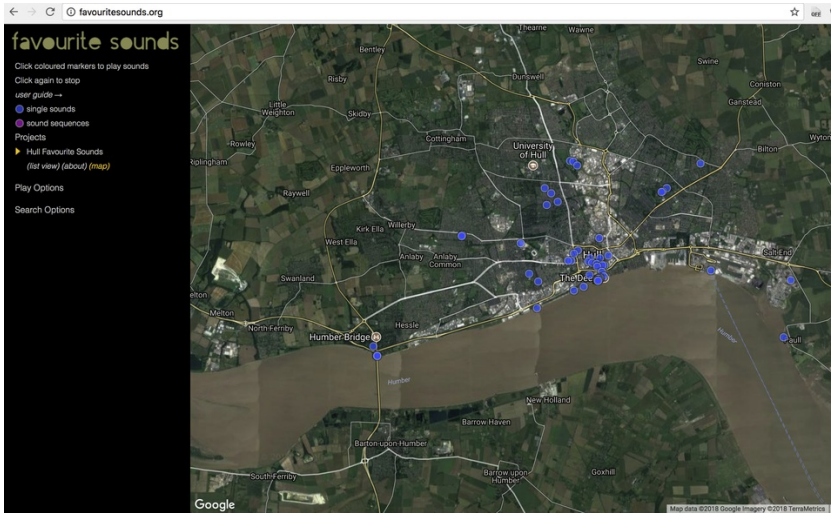


Figure 17 Favourite Sounds by Peter Cusak. Peter Cusack. Design: Kirsten Edwards. Programming: Nigel Currie (Northwind Trading)

Sonic cartography places the cartographic at the center—adding to a map's capacity to enrich a multi-sensory reading of space. The acoustic platform, *Radio Aporee* (Fig. 18), started in 2006 as a global soundmap dedicated to field recording, phonography, and the art of listening. In connecting sound recordings to their place of origin it creates a publicly accessible and collaborative sonic cartography project in which a feed of new recordings lend access into the site. These sound recordings might be ghost trains on an abandoned bridge or a Brazilian football game, a foghorn, or a forest—an opportunity to enter unknown worlds.

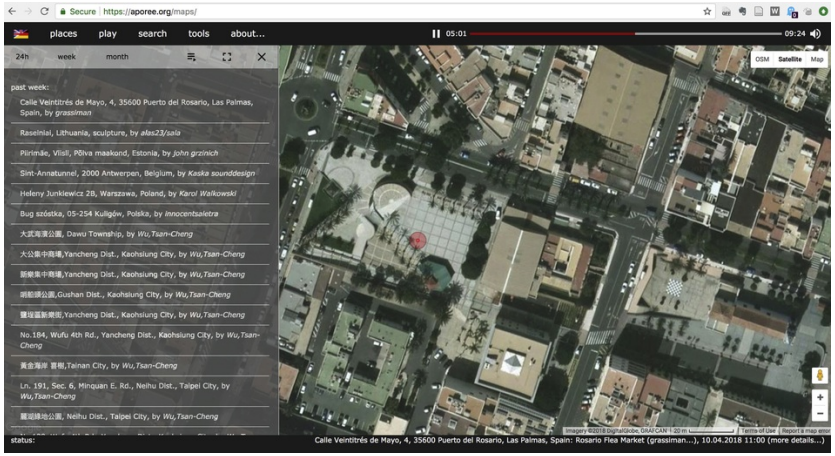


Figure 18 Aporee Global Soundmap © Udo Noll 2000 – 2018

Sound, as Ppracticed or Pperformed

The soundwalk, as defined by Westerkamp (member of the *World Soundscapes Project*), focuses on listening to the environment and embracing every sound that we hear. Andra McCartney provides an historical overview of the practice and Antonella Radicchi has written a publicly available *Pocket Guide to Soundwalking* which, similar to practices of active sniffing while smellwalking, promotes active listening.

Tactile Mmapping

Tactile mapping is dominated by haptic renderings of the landscape for, and by, communities of visually-impaired users. The Perkins School of the Blind in Boston, MA, USA is home to an archive of historical tactile maps including experimental, improvised, hand-made raised surface maps, embossed maps, and a bespoke, 13-ft diameter, spherical tactile globe. Recent years have seen considerable technological and material innovations including vacuum forming, 3D printers, embossers, and swell paper. While slightly tangential to the remit of sensory maps as representations of physically sensed data, the materiality and improvisation at the heart of maps that are made to be felt as a user-centered specialist field are important to note.

Micronesian stick charts are interpreted navigational aids in which the tactile pattern of the waves is output in the same modality through a different material; made from coconut fiber and cowrie shells, they are designed to represent wave patterns and currents facilitating navigation across seas lacking vertical landmarks. The shells represent islands or atolls, the straight lines represent consistent and predictable waves and the curved lines represent swells. It is thought that these highly individualized charts may not have been carried on voyage but rather memorized before setting out.

Bronze cast 3D map models are increasingly common in cities and major parks worldwide. They fulfil a dual role as dimensional city summaries for the sight-impaired and tourist attractions for the sighted giving a relationality, especially to complex and dramatic dimensional landscapes such as Edinburgh and Tübingen. The bronze relief maps are frequently placed in public spaces where they are touched by passers-by.

Visual Mmapping

Since maps most often represent the seen world, this section will focus on examples of when the visual is reformatted into alternative sensory modalities.

Visual, Ooutput as Ttouch

The Inuit have been carrying carved pieces of driftwood that act as coastline maps for over three hundred years. They were made to be felt rather than looked at; the land is abstract with the focus being on the view of the fjords, islands, and glaciers that form the shape of a coastline when seen from an ocean kayak.

To aid navigation for the visually-impaired Anne Gardiner focused on the design and production of vacuum-formed tactile maps. Her scientific approach sought a set of guidelines that rendered the map as an object that the reader would find pleasant to touch, easy to distinguish, include differentiated symbols and maintain consistency. One project, a countryside walk, also specified where the sequential trail maps should be situated with clear guiding strips to take the user from the site of the relief map to the start of the map's depicted zone. In creating a commissioned project, in the *Swiss Alp Atlas for the Blind* (Fig. 19) Anna Vetter encountered the issues of the sighted designing for the sight-impaired; her early attempts to create symbols for railway tracks looked great but were

indistinguishable to the blind from the symbols for roads and boundaries. Symbol differentiation requires scale changes and braille text is a heavy user of space. The fingers feel in completely different ways to how the eyes see; through touch a picture is built from the details as much more of the tactile map is retained in memory, whereas through sight an overview can be gleaned prior to drilling down into the detail. Understanding how non-visual sensory maps are read is as important as the sensory information they contain.

Figure 19 Tactile Map of Switzerland (Lakes and Rivers) © Anna Vetter 2018

Future Ddevelopments

Future developments in sensory mapping might equally revolve around the communication of multi-sensory datasets, explorations depicting sensory voids, and place-specific mapping investigations deriving from alternate sensory perception such as thermo-perception and proprioception. Our current inability to replicate smell and taste digitally for direct communication is similar to sound mapping practices of the 1970s and there are a number of theoretical papers and design projects that speculate as to how this might function henceforth; notably cybercartography, haptic soundscapes, a speculative odor phone, and a smell camera.

As a performative, relational construct the sensory map is processual, placing the map reader at the center. Seeking voids between sensory stimuli is increasingly important within agendas of well-being and relaxation. Rather than isolating ourselves from sensory overloads with gadgets, the sensory map can aid people to find quiet, fragrant, soothing restorative environments. From the *Hush City* app, a new open source soundscape map will emerge locating quiet spots in cities, an approach that other sensory practitioners might seek to emulate. Many sensory maps derive from data captured in-situ, however projects such as *The Good City Life* might use methodologies deriving data from visual social media platforms, but in realtime, to create alternative navigational route maps through city spaces. Accessibility, and independence in decision-making will be an area of future research focus. With increased knowledge as to how humans experience (and how they want to experience) the sensed environment, so the possibilities for future sensory maps and navigational systems will develop.

Beyond the over-simplified confines of Aristotle's five senses, sensory mapping has potential to investigate other sensory responses. Emotional states can be measured through galvanic skin response (GSR) as featured in Christian Nold's work on bio-mapping in which geo-located measurement of emotional arousal is mapped, analyzsed, and presented visually. It would be exciting to experience maps of ~~kinaesthesia~~kinesthesia, of nociception~~nocioception~~, of chronoception through a range of output forms, and work has been already been published on a methodological approach to the detection and recording of urban spatial thermoception. With an increasing interest in qualitative perception as valid datasets for mapping there is a call to develop more critical cartographic approaches that accentuate non-normative experience as communicated in this nascent field.

See Also~~Cross References~~

Affective Mapping; Art and Cartography; Cartographic Animation; Critical Cartography; Cyber Atlases; Digital Storytelling; Indigenous Mapping; Mobile Mapping; Information Graphics; Performative and Embodied Mapping; Psychogeography.

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Abstract

Sensory maps depict the world as it is qualitatively experienced, drawing on alternative human sensory modalities to call attention to the more-than-visual sensory characteristics of place. Sensory maps combine aesthetics wit empirically-sensed datasets to both depict personal, temporally-specified realities and to advocate the world as individually constructed. As such many sensory maps are exploratory and artistic in nature. Sensory mapping's roots can be traced to historical desire to monitor changing urban environmental conditions and to navigational pragmatism. Historical practices that focus on sensed data have led to reforms in public hygiene, the quality of sonic environments, and human-scale urba planning that prioritizes diversity and well-being. Contemporary practitioners, concerned with the emotional, embodied, and affective aspects of cartography, utilize multiple sensory output media in addition to traditional paper and digital forms in order t draw attention to sensed, subjective characteristics and their relationship to place. Where sensory mapping has a pragmatic aim, urban psychogeographic mappings tend towards a political defamiliarizationdefamilarizion of known environments, drawin attention to emotional and affective powers of the natural, cultural and political. One prime hybrid example is Krygier's Guide Psychogéographique de OWU-(, the result of an improvised, multi-sensory project with young students.

Keywords: Edible; Embodied; Experiential; Map; Mapping; Psychogeography; Senses; Sensory; Smell; Smellscape; Sound; Soundscape; Tactile; Taste; Touch

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Queries and Answers

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Answer: Should read: Dr Kate McLean