Sensory Informants
A Guide to Mapping Ephemeral Data

Thesis Presented By
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Abstract

Mapmaking, an extremely evolved field, is a predominately visual sensory experience. What if we invited map designers to incorporate sensescapes into maps to allow for more engagement, creating a richer interactive experience. The following investigation, based on a series of case studies and experiments, is meant to serve as a prospective guide to empower map designers to think about maps and mapmaking in different sensory ways. Through understanding the richness of combining sensory data with spatial representation, we can shape new kinds of knowledge and experiences.

Keywords | Mapping, Experience, Senses, Sensescapes
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INTRODUCTION AND INITIAL QUESTIONS
Our capacity to process complexity is the result of the unified sum of our senses; each sense, working in harmony, pulls in loads of information that our brain pieces together to help us interpret the endlessly intricate narrative unfolding around us.

Eric Boam, Frog Design

What if spatial maps could convey other sensory experiences through visualizing sensory data? What if spatial maps told stories through sensory data? What if spatial maps provided an experience enabling us to explore and understand locations with the support of sound, taste, touch, or smell? Spatial mapping continues to grow in both the physical and digital worlds. Years ago mapmaking was accomplished by carving pictures in stone while today, maps prosper through an abundance of forms: diagrams, GPS, online visualizations, informational pamphlets, and other means, both interactive and static. Due to the success of these highly visual forms, users are enabled to carry out a number of activities on a daily basis, but four enriching elements have yet to be included: sound, smell, touch, and taste.

While listening to a visually impaired woman describe her experience of the Boston transit stations, it became apparent to me how important the sonic environment was to her understanding of space. Unable to use a map, every last tinkering noise—those small noises most of us do not pay attention to—became a vital dataset allowing her to better understand the information that lay before her. But what were those sounds? What made them so important to that particular location? How did they impact her understanding of the space? How did this information support her connection with this space?

In the world of spatial mapmaking, map designers have spent little time applying such sensations to their geographic layout. There is no form or function for displaying such datasets. Considering the sensory experience as a new form for envisioning and understanding geographic space would empower map designers to notably heighten and change the way place is represented.
Sensescapes the idea that the experience of the environment and of the other persons and things which inhabit the environment, is produced by a particular mode of distinguishing, valuing, and combining the senses in the culture under study.

Indexicality is one of three sign modalities and is a phenomenon far broader than language, the which, independently of interpretation, points to something—such as smoke be index of fire or a pointing finger—works indexically for interpretation.

On a daily basis, we use our senses to explore our surroundings, employing that information to place things into perspective—the green light signaling us to go, the beeping of the UPS truck as a reminder that it is backing up, the smell of raw fish indicating we have passed an outdoor market—all of these indexical behaviors expressing the environment around us.

All humans experience a sensorial connection with their environment. In The Theory of Affordances James Gibson makes the argument that “the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill.” Our senses afford us the ability to recognize information—relate to it, feel something from it. Map designers have adopted a set of limitations by not looking at the display of geographic information through a sensory data lens, despite our senses being such a powerful influence. For years, map designers have enabled their audience to understand geographic space from a single visual perspective while other interpretations wait to be unearthed. Empowering map designers to consider our sensescapes will give countless opportunities to create a richer mapping experience.

Sensory Informants explores how to collect, visualize, and implement sensory data into spatial maps imagining a possible future where maps allow us to experience, understand, and discover locations through sensory stimulation.
At the outset of my research, I was drawn to examples of the interplay between experimental mapmaking and spatial mental models. Familiarizing myself with the work of artist, illustrator, and animator David Lemm, I felt inspired to explore the opportunities experimental mapmaking has to offer. His work, self-gathered data displayed through artistic reflection, paints a beautiful picture of perception in mapmaking. Through these illustrations, Lemm shows that our impression of geographic place can be much more abstracted than what maps typically show. His work allowed me to question the form of traditional mapmaking: what other forms could maps take? How do we define mapping? Why do maps not accommodate our perceptions and the fact that we remember places in such abstracted ways? How can I investigate this experimental vein further?

This curiosity stirred a motivation for me to know more, and I have added this section in hopes it does the same for you. Reaching out to David Lemm, I asked him a series of questions in regards to my fascination with his work. The following are my questions, his responses, and captivating work.
Lemm I’m a visual artist based in Edinburgh, Scotland. I studied animation at Duncan of Jordanstone College of Art and Design in Dundee, Scotland. Graduated in 2006. I work in a range of projects including residencies, research projects, exhibitions and commissioned illustration/animation work using a range of techniques from digital techniques to paper cut-out. Broadly speaking I’m interested in visual communication and ideas relating to how we perceive, navigate, create and quantify to make sense (or otherwise) of the world and our subjective experience of reality.

Lemm I've always loved maps and was always poring over one on long car journeys with my family when I was a kid. I like to have a map whenever I visit somewhere new and often use that graphic, birds-eye view of the place as framework to fill in my mind as I explore. I became interested in more experimental mapmaking after screen-printing on old sea charts for a few years.

Lemm I began printing on them as part of a research project with a library of cultural anthropology, which specialized in books about indigenous peoples, mainly of North America. I was really interested in exploring and interpreting systems for defining these realities, far removed from the world we recognize—looking at shamanic practice, cosmology and the relationship indigenous cultures have with nature/place in particular. Working directly on the found, redundant sea charts was influenced by the Plains Tribes’ tradition of ledger art.

Lemm In printing on maps/charts specifically, I was keen to highlight the importance of place to all people and to create a contrast between the physical mapping/organization of what we define as real with the unknown, unrealized and imagined. This is still a key concern.
I became more interested in cartographic/diagrammatic motifs, symbols and conventions and began re-purposing these as aesthetic or illustrative devices. I think it’s the graphic language, aesthetic value and ideas around assumptions of truth/definition of reality, which attract me most, to maps. 

Lemm Could you explain a bit about the experimental maps from Mapping Eigg?

This series was the outcome from a residency on the Isle of Eigg on the west coast of Scotland. I was invited by the lifeoffgrid.net project at University of Edinburgh to examine how maps are perceived and used on the island, relating to the infrastructure of an off-grid community—exploring their significance and value as tools, instruments of organization but also as material artifacts and repositories of meaning. I was interested in exploring the idea that maps fundamentally describe how we navigate the world through graphic abstraction, how markings in the land can influence graphic notation or vice versa and how the experience of space/place can be represented visually.

So I spent two weeks in a bothy, as part of the Bothy Project, exploring the island and meeting with some of the islanders to look at and chat about maps. I became interested in how maps seemed to be the catalyst for story-telling, so thought I would try and make work using semi-abstract, cartographic, and diagrammatic motifs to tell the stories I had experienced/discovered on the island, aiming to represent how I perceived and remembered the particular experiences and the spaces they occurred.
The resulting “maps” aim to represent particular narratives from conversations, journeys and observations made during the residency—referencing locations, routes and elements of visible/invisible infrastructure. To create the images, I settled on what narratives I wanted to “map,” and started drawing out how I could represent them, developing a visual language.

Part of the brief was to have a tangible outcome, perhaps an edition, so I decided to create lino-prints, turning the bothy into a mini print studio. I had originally taken printing materials to do workshops with the school and local community. I really enjoyed printing in an environment out with the studio, but felt the images still needed developed, so when I got home I worked the images up digitally and created a screen-printed edition.

Hopkins Do you think memory and experience play a role in navigation through place and space?

Lemm I think of memory/experience more as being the past tense, when I am no longer in a place. Almost as if there is a version of the place in my mind which exists how I’ve organized it, so it makes sense to me and reflects my experience. But in terms of real life, in the present tense trying to actually find somewhere or crossing a street, I think looking, wayfinding and actually engaging with the place as it is appears, is much more important.
Hopkins  May you tell me a bit about the experimental mapmaking workshop you held in London this past summer? What types of experiments did you execute with your participants? Did you ask your participants particular questions? Were there any phenomenon that surfaced within these experiments?

Lemm  As part of my residency project at House of Illustration, where I am exploring the development of the Kings Cross Estate, I hosted a workshop where I invited participants to consider mapmaking. Key ideas were to consider: what a map can be, what it can represent, how a map can define where we are/where we are going/where we’ve been—both physically and symbolically—how maps influence our perception of a space/place, and how maps literally define our place in the world—physical and mental identity. I was interested in the idea of bird’s-eye vs. cockpit views as methods of navigation, so introduced this as an idea also.

With all this in mind the idea was to create a personal map of the Kings Cross estate. So we explored the Kings Cross environment, recording/mapping our personal experience of the place, perhaps in a way we hadn’t before—playing with the surroundings whilst considering space and how accurately traditional maps represent this experience. We then made some illustrative maps—exploring visualization techniques and materials. We collated the maps into a zine—a mini atlas of sorts—and a time capsule recording what had been experienced on that day, in a place that is changing daily.

In terms of outcomes/phenomena there was perhaps reluctance from some of the participants to acknowledge the pictorial representations of the place they had made as ‘maps.’
INCENTIVE

THESIS PROPOSAL
In the fall of 2015 I had the pleasure of meeting sound artists Sam Auinger and Bruce Odland. Sam and Bruce create installations that change the way we hear allowing us to re-connect and engage with our environment.

It was through Bruce and Sam that I had the opportunity to listen to the experience of the visually impaired woman describe her auditory understanding of Boston transit stations. Grasping the importance of our sonic environment I began considering the four senses not typically used in spatial maps and their relevance with geographic place. During my conversation with David Lemm, he had spoken about perception as making sense of the world and our subjective experience of reality. Sam and Bruce spoke much about sounds allowing us to make sense and re-connect with our environment. These notions drove me to realize that there is great value in how we perceive the world in total and that the opportunity of mapping sensory data has been overlooked.
Spatial maps are multipurpose utilities. We use them to tell stories, define boundaries, or for experimental purposes: geo-tagging, routing, and so much more. These highly informational utilities are used daily from GPS to transit maps, city guides to political diagrams, but it is rare that they explore geographic space from sensory stimulation.

Spatial maps define place in infinite ways through boundaries, rivers, border lines, population, zip code, roads, buildings, and mountain ranges, but humans are sensorial beings; we are wired to convert our senses into spatial data. Yet as map designers, we have failed to utilize such information. These collections of sensory data picked up during our daily life are a major influence on our perception of a place, and play an important role in cognition. So why don’t we create spatial maps overlaid with sensory data?
Eric Boam of Frog proposes that “Adding sound, smell, taste, or touch to sight would expand the intensity of a data experience, and likely create more nuance, with more impact than any single mode of representation.” Adding such an experience to maps could open a whole world of possibilities.

This guide was created for map designers, proposing a structure for collecting, visualizing, and implementing sensory data into maps.

For my personal study I have picked one of the four unused senses I mentioned before and will be focusing solely on that particular sense—visualizing and mapping sound where it occurs in a space through sound mapping. But first, let us explore methods for collecting sensory data.

Say a person wanted to spend their afternoon reading outdoors in a calm urban setting. A map overlaid with sonic data could help them navigate to a quiet, relaxing space. Perhaps a person wants to experience London’s Kew Gardens but is unable to get there, a pamphlet with a scratch and sniff garden guide could help them experience such a place.

While our senses are transient, they are still able to bring awareness to the attributes a certain place provides and impact our mental models. Mental models are psychological representations of real, hypothetical, or imaginary situations. They were first postulated by the American philosopher Charles Sanders Peirce, who postulated (1896) that reasoning is a process by which a human “examines the state of things asserted in the premises, forms a diagram of that state of things, parcecves in the parts of the diagram relations not explicitly mentioned in the premises, satisfies itself by mental experiments upon the diagram that these relations would always subsist, or at least would do so in a certain proportion of cases, and concludes their necessary, or probable, truth.” Cognitive scientists have argued that the mind constructs mental models as a result of perception, imagination and knowledge, and the comprehensiveness of discourse.

In 2005 scent artist Sissel Tolaas extracted sweat from twenty men. “At the onset of a fear attack the men would place the device under their armpits. Subsequently, the equipment would suck the sweat in and register its molecules. The samples were then sent to the Rese research catalogue via overnight service, UPS, where the original sweat samples were chemically simulated. The manufactured molecules were then ‘micro-encapsulated’—a nanotechnology process in which molecules are packed together in micro units (www.researchcatalogue.net).” Taking the micro-encapsulated simulated sweat molecule, Tolaas painted a gallery wall, mapping these scents for others to experience.
Sensory Exercises

And the six steps to recording data
For most map designers, we have not spent years training our noses; nonetheless, it is still possible for us to collect data. To help prepare the designer’s senses for such data collection I have listed a series of exercises for them to practice. Once the designer is ready to begin a project it is important to complete these exercises before collecting sensory data.

It is important to note that it is a very simple yet complex problem when collecting sensory data. One not only has to consider the elements of the environment one decides to investigate, but how in-tuned they must be in order to capture these transparent data forms. People spend years training their senses to collect such data. Consider artist Sissel Tolaas, the world’s pre-eminent olfactory cartographer. “Tolaas is one of the few artists in the world working with smell. Her installations explore real scents; that is, body odors and city fumes. Her sweat simulations not only push reflexive disgust to the limit, but they also skily tweak certain cultural prejudices. ‘It’s to do with cleanliness but also over-cleanliness,’ Tolaas says. ‘And fear, racial tolerance and globalization.’”

With the senses, we have amazing tools available to us for free. By triggering them, and telling them to do things, you won’t believe what a completely different meaning life takes.

Sissel Tolaas

STIMULATING YOUR SENSES
Sound—Place your hand on a partner’s shoulder and close your eyes. Have them lead you around a set area with your eyes remaining shut the entire time. As you blindly explore the space, focus on your ears and what they are telling you. Can you feel the pressure change as you leave one space and enter another? Does one room echo while another stays motionless? Which noises aid in the way you interact and move through each space? Part two: After you finish your walk, take a moment to reflect and answer those questions. Spend a few moments writing down how that exercise made you feel or changed the way you think about the space. Next, lead your partner around the same area. Have them reflect with you to compare results and take note of their experience. In the event you’d like to record and collect sound, the Tascam portable digital recorder paired with in ear binaural microphones is an excellent tool for tracking such sensations.

Smell—Have a partner set out an arrangement of smells (this can be food, flowers and plants, tea, wine, clothing objects, perfumes, etc.). With your eyes shut, have them lead you to the arrangement. Next, have them guide you towards each object, one at a time, and without touching the object, inhale the odor. As you name the aroma you smell, have your partner record what you guessed.

Touch—Go for a walk around a place—it can be a city, inside a shopping mall, through the woods, etc. As you walk, pay attention to what you feel. What elements trigger that you have gone from grass to pavement, or that you are about to cross an intersection? What sensations inform you that the space is cold, hot, or muggy? Can you feel wind or a change in the air? This walk should be at least fifteen minutes.

After finishing your first walk pick a completely opposite environment to repeat this exercise. How do surfaces differ? How do indoor environments compare to outdoor? As you’re doing this have a partner join you on two or more of your explorations. What changes or similarities do they notice? What factors do they take note of? How does their understanding of the space compare to yours? At the end of each walk record and analyze your findings.

Taste—After smelling all the objects, open your eyes and see how you did. How many did you guess correctly? Why were some smells harder to guess than others? Smell the one you guessed wrong and try to pick out specific aromas unique to that object. Do this as little as five times with five different sets of objects to help train your olfactory bulb. The more you exercise your nose, the better it will become at detecting smells.

With a partner, and eyes shut, follow example one from smell and substitute the objects for material that can be consumed. Taste each food given to you and have your partner record your observations. What do you think this food is? What is its texture? What notes of taste appear? Is it aged? Balanced? Acidic? Complex? Record your findings and keep track of your results every time you complete the exercise.

Note: These exercises are meant to stimulate and train your senses so that you can be better equipped and aware when collecting sensory data. For most, you are encouraged to have a partner present. Having a partner present not only helps in the conduction of the exercise and collection of your results but also helps you compare your results with another’s perspective. These exercises can also be conducted in larger groups of people.
In this section you will learn the six steps to recording data. A few vital points to consider are: where and how you will be collecting this information; if this information comes from a singular, personal data collection, a collection of crowd-sourced material, or a combination of both; the tools you need for collecting your data, as well as the input (data) and the output (form). The following lists a set of examples and steps to aid in the understanding of how sensory data should be collected.

THE SIX STEPS TO RECORDING DATA

Step 1 The Who—Who is collecting this data? Is it you the designer, a writer, artist, scientist, etc?

Step 2 The What—Next you should decide which type of sensory data you would like to record: sound, smell, touch, taste, sight.

Step 3 The Where—Where will you be recording this data? This step is referred to as the "area of specificity" in the example below. It is vital that you get as specific as possible during this step, noting descriptions such as the name of the place, any specific boundaries/area, size, location, population density, etc. This data may not be needed in the final model but is important information for designers to have and consider when brainstorming final outcome ideas. In this example data will be collected inside Boston's Harvard Transit Station.

Step 4 The When—When will this study be taking place? Here it is necessary to determine when and how long it will take for this data to be collected: one day, a week, a month, three months, a year; how many hours per day; what specific times during the day, what month(s)? Again, specificity is key.

Step 5 The Why—What's the purpose of collecting this dataset: for a friend, to solve an urban issue, your boss asked you to, out of plain curiosity? Like all projects it is important to have a firm understanding of why you are doing something.

Step 6 The How—How will you be collecting this data? Will this be a collection of your personal data? Do you plan on crowd sourcing the data, or plan on a combinational dataset or the combination of crowd-sourced and personal data. (Last sentence could be defined in margin of book) What materials do you need to successfully collect this data? What is your input and output?
SCENARIO ONE

Collecting crowdsourced aromatic data of Kew Gardens, London

Kew Gardens wants to bring in more visitors, advertising to people outside of London about the garden experience. There is an abundance of smells created by the gardens and they want to share that experience through pamphlets and posters. They hire an information designer to solve this problem who decides to make the pamphlets and posters a map of the garden with scratch-and-sniff interactions. The designer agrees that the smells should be crowd-sourced through surveys handed out to people visiting the park during their summer months, June to August.

Step 1  The Who—Information designer
Step 2  The What—Smell
Step 3  The Where—Kew Gardens
Step 4  The When—Summer, June to August
Step 5  The Why—To bring in more visitors
Step 6  The How—Crowdsourcing, surveys

Input scent data—output scratch-and-sniff pamphlets and posters

Palm House
Kew Gardens, London England

Founded in 1840, Kew Gardens is the world’s largest collection of living plants including more than 30,000 different kinds of plants. One of London’s top tourist attractions, Kew Gardens creates an enchanting experience through its inspirational gardens, library, buildings, and landscapes.

Historic Waterlily House
Kew Gardens, London England
SCENARIO TWO
Collecting personal data from the sound environment inside a library
An urban designer is working on the re-design of public libraries. It’s their goal to create an environment that can be both noisy for the collaborative workers, yet quiet for the readers and students. Their plan is to map the sound environment of current libraries by collecting and analyzing their own data through extensive note-taking, sketching, sound recordings, and video over the next two weeks. Not only do they plan to use this data to re-design a more user-friendly library, they also decided to place an interactive sound map at the entrance of these libraries helping people navigate to the place that best fits their studying needs.

Step 1 The Who—Urban designer
Step 2 The What—Sound
Step 3 The Where—Libraries
Step 4 The When—Two weeks
Step 5 The Why—Urban re-design of libraries and sound maps
Step 6 The How—Personal data, note-taking, sketches, sound recording, video

Input sound data—output libraries accommodating noisy and silent users.
SCENARIO THREE
Collecting combinational data from the top wines in Italy.
An environmental designer is interested in sharing a wine-tasting experience from the top wines in Italy through the combination of crowd-sourced and personal data. Their personal data was collected over the past month during their visit to Tuscany. The designer plans on crowd-sourcing the other half of their data during the next month. They plan on collecting the crowd-sourced data through an online website and surveys they sent to friends who live near and visit Tuscany vineyards. Their personal data was collected in a series of notes and pictures taken during their visit.

Step 1 The Who—Environmental designer
Step 2 The What—Taste
Step 3 The Where—Italy
Step 4 The When—One month
Step 5 The Why—To share a wine-tasting experience
Step 6 The How—Combinational data, note-taking, website, and survey’s

Input taste data—output speculative headpiece for tasting wines in Italy

Note these are examples of the possible scenarios that could happen. It is important to note that not all of the outputs need to be a physical map. Mapping can consist of taking data points and plotting them to physical objects. As you begin to explore this territory you will start to find that there are endless situations that can develop and multiple systems for mapping its data. You will also notice how in-tuned your senses quickly become after collecting such data.

Montalcino: A quaint hill town located in Tuscany, Italy. Montalcino is famous for its Brunello di Montalcino wine. Highly productive grape vines used for making this famous wine dominate the lower slopes of the Montalcino hills.
CASE STUDY 1

THALYS SOUNDS OF THE CITY
As we move into the extra-visual era of data representation, it is important to remember that the goal is not simply to find the best alternative or compliment to the visualization. Rather, the ideal is to experience the data more richly...experiencing data is what humans are meant to do.”

Eric Boam, Frog Design

An interest in the senses and sensory mapping is nothing new; in fact, during the 1790s Jean-Noël Hallé began creating his own hygiene-focused smell maps of Paris. “When new ideas arose about political equality and hygiene, physician Jean-Noël Halléon took on a six-mile odor-recording expedition along the banks of the Seine. His map-making technology consisted of nothing more than a notebook and pencil—and, of course, his nose.”
In my research I have discovered that spatial maps take many forms. I have seen artistic maps created out of Jell-O (see Liz Hickok’s Jelly NYC, opposite), and intriguing scratch-and-sniff maps (see Nicola Tilly’s scratch and sniff maps, fig. 1). There are also some brilliant finds in the speculative world such as Brian House’s Quotidian Record (fig. 2), a record mapping sound data from a continuous year of House’s location-tracking data as well as Amy Radcliffe’s Scent-ography—a device capturing and replicating the scent of objects and places (fig. 3).

While some are more successful and effective than others, we can come to find that there is a great amount of experimentation happening within the sensory mapping realm.
Thalys Sounds of the City is just one of the many brilliant projects using sensory data. Thalys is an international high-speed rail travel network in Europe. Founded in 1996, this rail service is the only one to achieve a high-speed international link between four countries. Not only has Thalys been a commercial success, transporting over a total of 100 million passengers, but a technical one as well providing WiFi on board since 2008. Their objective: “To offer the best transport solutions between Paris, Brussels, Amsterdam, and Essen.”

In May of 2015, three out of four weekends were holidays in France. Thalys saw this as an opportunity to trigger people to book tickets to visit cities on their network. Thalys knew they couldn’t do this alone—the company needed help conducting research and creating the final piece that would draw in customers.

To solve the problem, Thalys contacted Rosa Park a French design agency specializing in strategy. Rosa Park decided that the way to encourage travel was by letting the Thalys destinations speak for themselves. They did this by capturing the sound identities of Paris, Amsterdam, and Brussels through a special sound recording device they carried about each city. “The sounds included overheard conversations, street musicians, language lessons, market sellers, church bells, scam artists routines, and hundreds more.”
The installations changed perceptions about nearby cities on the network. Thousands of people interacted with them and visits to Thalys.com spiked by 20,000 impressions, a 58.5% increase on the average for that time of the year. During France’s three holiday weekends, trains between Paris, Brussels and Amsterdam sold out. Ticket data also reported an increase in the flow of passengers into France from Amsterdam and Belgium.  

Taking their recoded sound data, Rosa Park transformed their information into three billboards—giant maps displaying each city and equipped with multiple locations to plug in headphones for a sound experience (see fig. 23). Through this interactive piece, people were able to explore a city through its soundscape.  

*The installations changed perceptions about nearby cities on the network. Thousands of people interacted with them and visits to Thalys.com spiked by 20,000 impressions, a 58.5% increase on the average for that time of the year. During France’s three holiday weekends, trains between Paris, Brussels and Amsterdam sold out. Ticket data also reported an increase in the flow of passengers into France from Amsterdam and Belgium.*

The Thalys Sounds of the City project is a successful sensory map. It allows the users to connect with the data, physically hearing specific sounds from particular areas creating an enriched experience. The Thalys Sounds of the City project is a successful sensory map. It allows the users to connect with the data, physically hearing specific sounds from particular areas creating an enriched experience. If these billboards were merely static posters many viewers would be less interested and less engaged with the data being presented causing the visual to become unsuccessful. The Thalys Sounds of the City project shows how persuasive and powerful sensory mapping can be, not only from a human perspective but also as a marketing tool.
CASE STUDY 2

KATE MCLEAN SMELL MAPPING
Kate McLean, artist and designer, is a creator of smell maps of cities all around the world. "I focus on human perception of the urban smellscape. While the visual dominates in data representation I believe we should tap into alternative sensory modes for individual and shared interpretation of place (Kate McLean)."

Through individual, group, and collaborative smellwalks, sketching, graphic and interactive design, as well as smell generation and smell diffusion, she is able to capture the identity and visualize specific smellscapes. She has even gone as far as creating her own "smellie guide to smellwalking," categorizing smell, the stages of a smellwalk, and how to take notes and record your findings.

"As a means to facilitate exploratory and explanatory conversations about individual perception of smell" designer Kate McLean created a series of watercolor maps to "appear as icons in the smell-sketch map aspect of the installation (Kate McLean)."
Here Kate's Amsterdam smell map is broken down into the six steps of data collection.

**Step 1** The Who—Kate McLean

**Step 2** The What—Small

**Step 3** The Where—Amsterdam

**Step 4** The When—April 2013, ten smell walks over a period of four days

**Step 5** The Why—to understand human perception of the urban smellscape

**Step 6** The How—Combinational, crowd-sourced and personal data collection

The subsequent data resulted in 650 smell detected by the 44 people participating in her smellwalks. This group undertook ten smellwalks over a period of four days. Based on the written descriptions from participants, McLean identified fifty broad categories of both frequently mentioned and curious smells, featuring them on her maps.

To encode the data collected, Kate comprised a visual encoding system. *Dots mark the origins of the smells, concentric circles indicate their range and the warped contours allude to potential smell drift in the north and south–westerly winds encountered on the days of the smellwalks.* The final outcome resulted in both a static and interactive video map.

The Smellmap | Amsterdam
Kate McLean
Digital, 2013

In April 2013, Kate McLean took 44 people on ten smellwalks in Amsterdam. *Based on written descriptions from the smellwalkers, 50 broad categories were identified. Both frequently mentioned and curious smells feature on the map. Dots mark the origins of the smells; concentric circles indicate their range and the warped contours allude to potential smell drift in the north- and south-westerly winds encountered on the days of the smellwalks. It is estimated that humans have the capacity to discriminate up to 1 trillion smells and our experience is highly individual; to walk and sniff is to know (Kate McLean).*
Kate McLean has designed numerous smell maps like this, entrancing visualizations pulling the viewer in, wanting to know what they’re all about. Looking at Kate’s Amsterdam version, what if she were to incorporate the physical smells into her maps? How would this change the users experience and understanding of this information? Would tangibly experiencing the aromas detected in each location bring forward certain memories or shape their understanding of each place?

Though the involvement of engaging the senses are omitted, Kate McLean does an excellent job of creating a framework to encode and visualize the data collected. Through the interactive form, she is providing the users with an alternative way to understand and experience this information. If Kate McLean were to add physical smell to these maps she would fully execute the idea and experience she is trying to get across—the smells of Amsterdam.
EXPLORATION 1

COLLECTING SOUND DATA
Kate McLean’s smell maps are constructed from a clear framework. Using this framework as an outline I constructed my own experiment selecting sound as my form of sensory data.

Step 1 The Who—Jessica Hopkins
Step 2 The What—Sound
Step 3 The Where—North End, Boston, MA
Step 4 The When—Winter 2016, three smell walks over a period of three weeks in February
Step 5 The Why—For map designers
Step 6 The How—Personal data collection from 22 sound recordings; written descriptions, paper, pen/pencil
Input sound data—output sound visualization
Set in Boston’s North End, I began my sound collection by gathering sound data from five different locations: Atlantic Avenue, at the corner of Fleet and Hanover Street, inside Paul Revere Square, at the corner of Salem and Prince Street, and finally on Cross Street near the ramp to Interstate 93. The day was February 10th and the weather was brisk with flurries. With my note pad and pen I recorded locations, every sound I could hear, quantitative information such as volume, pitch, duration, and direction of the sounds as well as qualitative measures of the sounds.

While I collected this set of data I had my classmate, Skye Morét, use an in-ear binaural microphone recording system as a second form of documenting the soundscapes. Each location was listened to for a total of five minutes. A series of photographs were taken on my phone as the last piece to my documentation.

Boston’s North End affords a feeling of separation from its adjoining neighborhoods. Surrounded by Italian bakeries, restaurants, cafes, and thick accents, the North End administers a charming atmosphere leaving you with the feeling you have just entered another world. It’s a neighborhood where people want to know one another, with friendly conversations echoing through the vibrant interwoven streets. It’s a place of history—a tourist destination where many come to walk the Freedom Trail and discover where the silversmith Paul Revere once resided. It’s a place where the land slopes into the Boston Harbor; seagulls call, and airplanes can be heard as they take off and land at the nearby airport. The North End is many things to many people, a place to call home, and a desirable area for the enchanting lifestyle it provides.

One can’t help but notice the energy that radiates from the area. Whether it’s the lively chatter of tourists or the soft whispers of locals, the North End beckons with its vibrant atmosphere. The area is rich with history, with the Freedom Trail running through it, and is a place where one can truly immerse themselves in the culture of the city. The North End is a place where one can find a sense of belonging, a place where the past and present coexist in a harmonious blend.

North End Boston
Another view of North Square Park, where the popular restaurant Mamma Marias resides.

North End Boston
Another view of North Square Park, where the popular restaurant Mamma Marias resides.
Sounds recorded: car door shutting, car starting, car honking, cars passing, footsteps, wet road, truck starting, truck humming, truck back-up beep, airplane, seagulls, car wheel over crunchy snow, dolly, birds tweeting, conversation, water slushing against the docks in the harbor.

STOP 1 | ATLANTIC AVENUE | 12:00PM

Sitting on a bench at Atlantic Avenue, we were placed between the harbor and the street. Being located in front of the harbor made this space feel open and have a sense of calmness. Activity was moderate, cars were passing in waves and swishing the water of the streets as they moved. Across the street, a man pushed a clanking dolly as he went to pick up trash, the engine of his truck humming as he proceeded with his job. The air was filled with the faint sound of seagulls and airplanes as they took off across the sky to their desired destinations. There were the occasional passing footsteps, wet, low pitch and rhythmic; a low toned, short conversation, and the classic high pitch of an angry car horn in the distance.
Sounds recorded: cars passing, car starting, car rattle, quiet tone, footsteps, wet roads, airplane, cutting saw, sirens, light conversation, truck humming, distant beeping, birds, car door shutting.

STOP 2 | FLEET AND HANOVER | 12:14 PM

Standing on the corner of Fleet and Hanover Street, underneath a blue sign that read “Tony De Marco Way” spot two was much more enclosed, with buildings surrounding us. At this point we had entered the inland section of the North End, and the activity bustled more than it had near the harbor. There were more cars and people passing us, light conversations being had, roads still sounding damp, and a constant high-pitched beeping nearby. Across the way a cutting saw squealed abruptly and high-pitched, suggesting the act of construction. A smooth and prolonged airplane passed in the distance for a second time, and the far-off streets sounded of distant sirens. At the end of five minutes a small group of tourists passed by—we noticed we were on the Freedom Trail and followed it to our next stop.
Sounds recorded: children playing, metal gate opening, sirens, footsteps, cars, squeaky truck brakes, humming trucks, airplane, faint conversation, warning honk.

STOP 3 | PAUL REVERE SQUARE | 12:24 PM

Pursing the Freedom Trail we arrived at our third stop: in front of the fountain at the Paul Revere Mall. This was the first location to be completely covered in snow. The area was open, calm, and peaceful and though known as a tourist area, the brisk day made for fewer visitors. I could hear footsteps as they crunched past me on the snow and a plane passed in the distance for a third time, smooth and mesmerizing. This area is a no-car zone but they were still faintly heard passing in the abutting street along with squeaky truck brakes and a warning car honk. To our left sat an elementary school; the heart-warming laughs and chitchat of children could be heard buzzing about their playground. These high-pitched voices were by far the most defining sound of the area.
Sounds recorded: conversation, beeping, fridge hum, squeaking entrance door, cash register, telephone, plastic sheets.

STOP 4 | MIKES PASTRY | 12:46PM

Taking a minute to warm up from the cold, we found ourselves inside Mike’s Pastry where we decided to conduct a bonus recording for the fun of it. The space was warm and active, bustling with people who knew each other, making for loud conversation in their thick Boston accents. It was a happy environment filled with joy. A telephone rang constantly and rhythmically; plastic sheets rustled in the background; a constant beeping came from the kitchen and the pastry display fridges hummed a steady tune. Every so often the cash register clunked open, and the entrance door squeaked a high-pitched sound as people flowed through.
Sounds recorded: trucks, cars, conversation, footsteps, wet roads, car dings, chain saw, hammers, sirens, birds singing.

Standing on the corner of Salem and Prince Street we had arrived at our busiest spot yet. Set in a dense neighborhood the area echoed of thumping hammers and brief cuts from a high-pitched wood saw. Cars whizzed closely by, and dinged as people locked and unlocked them. Trucks sat idle in the side streets, and the sound of dismal sirens returned in the distance. Across the street birds danced, chirping a cheerful musical tune.
Deciding to capture a second recording of indoor material, we stopped inside Polcaris Coffee Shop. A quaint store, with little space, Polcaris provided a friendly and peaceful atmosphere. The coffee shop consisted of freshly roasted coffee beans, tea, spices, candy, and other packed Italian goodies. An elderly woman hummed then spoke softly as she made a purchase, the entrance door creaking as she left. A delivery man dropped off his weekly order and made light conversation with the cashier. Behind the counter a plastic bin shut abruptly as it was filled with material and the light sound of shuffling footsteps could be heard. Only once the cash register opened, its loud gears and clunky buttons reflecting it was of old age.
For our final stop we ventured out of the North End’s neighborhoods to the busy streets bordering the area. On the sidewalk facing Cross Street, we observed an open space with a high volume of traffic moving in rhythm as the lights changed from red to green. A powerful, low-toned wind danced around us, and a woman in heels trotted past. There was the high-pitched sound of car brakes, angry bursts of honking, and sirens were now more apparent, closer and louder than before. This area was highly defined by the sounds of traffic.
For my final recording session, I planned out six more stops: at the intersections of Hull Street and Snow Hill, Sheafe and Margaret Street, Prince Street, Thatcher and North Washington Street, Cooper and Margin Street, and finally at the intersection of Endicott and Morton Street. After the completion of my third visit I had successfully completed the 22 sound recordings required for my scenario.

After examining my recordings and notes several times I designated six categories to group the sounds: transportation, birds, wind and water (such as the crunching of snow or wet sounds tires would make when passing by), human, construction, and miscellaneous (things like metal gates, push dollies, and other noises not belonging to the other categories).

DATA COLLECTION CONCLUSION AND RESULTS

The planned five stops quickly turned into seven—the two bonus indoor recordings, which allowed a glimpse into interior soundscapes as a compliment to the exterior. While the indoor recordings were fascinating, I decided to leave them out of the final visualization for it is always best to compare apples to apples. Capturing these soundscapes, I started noticing sounds that highlighted the North End’s soundscape, but the one trip and seven stops wasn’t enough to fully grasp this phenomenon.

For my final recording session, I planned out six more stops: at the intersections of Hull Street and Snow Hill, Sheafe and Margaret Street, Prince Street, Thatcher and North Washington Street, Cooper and Margin Street, and finally at the intersection of Endicott and Morton Street. After the completion of my third visit I had successfully completed the 22 sound recordings required for my scenario.

After analyzing my full set of data, the North End’s soundscape began to appear. At this point in time it became apparent that the North End is undertaking a great deal of construction, fixing and remodeling the brick buildings built so long ago, as well as constructing fresh store fronts as new businesses move in. I was intrigued when I realized I could hear an airplane humming in the distance at every location I recorded. Thinking about why this might be I realized that the Boston Logan Airport was just a mere three miles away, an obvious explanation for the continuous sound. Lovely tweeting songs could be heard among many streets as birds flirtatiously moved about as well as the friendly conversations of passers-by. There were cars passing, some streets busier than others, and the loud beeping sounds of trucks as they backed up to the sidewalks.

Note: The accuracy of this data would be much more consistent if taken over a year's time. Given the time restraints of this thesis, a month was dedicated to the collection of this data set.
CASE STUDY 3
Before placing the sound visualizations on a map, it was important I explored and studied visual ways of representing and translating the variables I chose to visualize: type, volume, and duration. “HALO is a visualization platform combining six different variables into a single, multi-dimensional band of light. These HALOs, developed by Peter Crnokrak and ORA Systems, are built to represent data such as patient health status, gaming performance, stock fluctuations, and anywhere users need to monitor and interpret massive quantities of complex data in real time.” Following are examples of this visualization used as a stock market platform.

HALO
ORA Systems
Interactive Platform, 2015

“HALO is a visualization platform combining six different variables into a single, multi-dimensional band of light. These HALOs, developed by Peter Crnokrak and ORA Systems, are built to represent data such as patient health status, gaming performance, stock fluctuations, and anywhere users need to monitor and interpret massive quantities of complex data in real time.”

Following are examples of this visualization used as a stock market platform.
While this application does not currently reflect sensory data or stimulate the four senses focused on in this research, it provides a strong structure for visualizing multiple variables of information at one time. "This ‘intelligent object for a post-data world’ is the first product of Peter Crnokrak’s 3D visualization systems that allow users to explore complex personal data in an intuitive and actionable way. It combines different data sets into a fluid multi-dimensional band of light as architectural dimensions of size, color, speed, complexity, brightness and wobble—signaling a new type of visual data language."²
Streaming from real-time data, these visuals combine data values creating distinct visualizations. These visualizations or HALOs, allow users to see changes in activity level whether it be for personal health or the stock market. To understand this through example, *HALOs being developed for the Apple Watch allow users to see changes in activity levels, calories burned and variable heart rate patterns over time as comprehensive pictures of health. Where athletes have large bright and fast moving HALOs, sedentary individuals' HALOs are small, dim and slow moving. It is fed off heart rate, blood pressure, even perspiration, and is engineered so you have an empathic connection to this digital representation of self.* The list of prospective users for the HALO visualization’s are striking, bursting with color, movement, and shapes. These mesmerizing figures put you in a trance as you analyze their meaning. Examining the real-time stock market HALOs (sandbox.ora.me/market#) the user is presented with a screen filled with information. On the left side boxes defining information such as specific companies, information about the company currently being looked at, and stock market notes explaining what the variables indicate. On the top right the user sees a box labeled ‘vertices,’ filled with small charts showing the real-time change as the day goes on.
For a first-time user, the stock market application can be confusing. The user is presented with a moving HALO in the center of the screen, pulsing or conducting ‘wobble’ as real-time data streams in. For a stock market professional, grasping the information being present may be a quicker learning curve than for someone without familiarity, but nonetheless, the user has to spend valuable time figuring out what exactly the visualization is telling him or her. Again, six variables are packed into one HALO. Color reveals current day loss or gain. Complexity of the HALO indicates its trade volume—the more complex the higher the volume. Speed and brightness suggest performance relative to a 50-day moving average. Size directs market capitalization while wobble implies short ratio as a measure of investor sentiment.

If the HALO is large, orange, moving quickly, bright, complex with lots of wobble this means that the stocks for the specific company are heading towards loss for the day, but with a high market capitalization trade volume, performance to a 50-day moving average, and a good amount of short ratio. Now, that is a lot of information to think about.
As I mentioned, a first-time user, grasping all of this information, could be quite overwhelmed, looking at the HALO, then to the descriptions in the lower left hand box, back to the HALO then back once again to the key just to understand this information—it’s a lot of work.

This stock market platform is also missing the option where a user is able to view multiple companies at once—an action extremely useful to the user. Speaking to the head trader at Oechsle International Advisers and demonstrating this visualization he stated “You never see a broker focusing on just one company, our screens display multiple companies at a time so we can easily watch and make comparisons. Something like this could be great if we were able to see multiple HALOs at once, then if one turned red our attention would immediately be drawn to that specific company.” He also mentioned that it could be useful to stream social media data as a seventh variable to see the effects it has on each company.

Playing with the screen, the user is also able to zoom into and out of the HALO, possibly causing confusion towards the actual size. Another troublesome aspect lies within the top right vertices box. The small charts presented allow the user to interact and change their level of percentile, which presents a huge issue. If this visual is streaming live data, the user should not be able to control the variables, for it disrupts the whole point of streaming live data.

Remembering that the stock market HALO application is still in beta form allows us to understand why this platform is not entirely seamless, and with a few tweaks this could perhaps be the new way of viewing and comparing stocks.
EXPLORATION 2

VISUALIZING VARIABLES
Using HALOs system as a model for defining and combining variables, as well as Jacques Bertin system of perceptual variables, I conducted the second part of my research: a series of studies to discover the best combination for visualizing the variables type of sound, volume, and duration. Coming up with possible solutions, I created nine combinations for linking variables.

HALO yields the dimensions of size, color, speed, complexity, brightness and wobble to encode information, a combination of visual variables allowing the user to understand the data being displayed. In 1967, French cartographer Jacques Bertin described the term visual variables in his book Semiologie Graphique. Bertin used the term to “describe the graphic dimensions across which a map or other visualization can be varied to encode information.”1 Creating a diagram, Bertin presented his system of variables with their corresponding properties. Over time Bertin’s system has been extended including other variables such as color saturation and in 1995 MacEachren introduce three additional visual variables—crispness, resolution, and transparency.

Using HALOs system as a model for defining and combining variables, as well as Jacques Bertin system of perceptual variables, I conducted the second part of my research: a series of studies to discover the best combination for visualizing the variables type of sound, volume, and duration. Coming up with possible solutions, I created nine combinations for linking variables.

Experiments with encoding the three variables through color, opacity, and length. Color indicates the type of sound: human, construction, transportation, wind/water, bird, or miscellaneous. Opacity reveals volume—where volume gets louder, the line produces a taller curved line, quieter noises produce smaller curved lines. Length of line determines how long the type of sound lasts for—shorter lengths for quick noises, longer lengths for more prolonged sounds.

**STUDY A**

<table>
<thead>
<tr>
<th>Type</th>
<th>Volume</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Color</td>
<td>Line</td>
<td>Length</td>
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**STUDY B**

Experiments with encoding the three variables through color, opacity, and length. Color, again, indicates the type of sound. Opacity represents volume—quieter noises a lighter opacity, louder noises a darker opacity. Length, like study A, represents duration.

<table>
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<tr>
<th>Type</th>
<th>Volume</th>
<th>Duration</th>
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<tr>
<td>Color</td>
<td>Opacity</td>
<td>Length</td>
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</table>
Uses shape, size, and pulse to encode the three variables type, volume, and duration. This time type of sounds is expressed through shape. Size indicates volume—louder sounds creating bigger shapes, quieter sounds creating smaller shapes. Pulse, imagining this as an interaction, signifies duration—a pulse that flashes quickly indicating a shorter sound and a pulse that flashes slower representing lengthier sound duration.

<table>
<thead>
<tr>
<th>Type</th>
<th>Color</th>
<th>Size</th>
<th>Opacity</th>
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<tr>
<td>STUDY C</td>
<td>Investigates color, weight, and size. Color represents type of sound; Weight represents volume—thicker circles for a louder sound, a thinner circle for lighter sounds; Size embodies duration—smaller circles for quicker bursts of sound, larger for longer ruptures of sound.</td>
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<table>
<thead>
<tr>
<th>Type</th>
<th>Shape</th>
<th>Hue</th>
<th>Size</th>
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<tbody>
<tr>
<td>STUDY D</td>
<td>Uses shape, size, and pulse to encode the three variables type, volume, and duration. This time type of sounds is expressed through shape. Size indicates volume—louder sounds creating bigger shapes, quieter sounds creating smaller shapes. Pulse, imagining this as an interaction, signifies duration—a pulse that flashes quickly indicating a shorter sound and a pulse that flashes slower representing lengthier sound duration.</td>
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</table>
Explores color, height, and weight to encode the chosen variables. Color, once again, represents type of sound. The height of a line signifies volume—the taller the line height the louder the volume—the shorter the line height the quieter the volume—the shorter the line height the quieter the volume—the shorter the line height the quieter the volume—the shorter the line height the quieter the volume—the shorter the line height the quieter. Weight or thickness of the line symbolizes duration of sound. Thicker lines represent sounds that last a longer duration; thinner lines represent sounds that last a shorter duration.

**STUDY E**
Tests shape, size, and line length—shape representing type of sound, size of shape indicating volume and line length demonstrating whether the sound lasted a long time or a shorter time.

**STUDY F**
Tests shape, size, and line length—shape representing type of sound, size of shape indicating volume and line length demonstrating whether the sound lasted a long time or a shorter time.
Explores shape, hue, and size to combine the chosen variables. In this study, shape represents type of sound. Hue encodes volume—a darker shade of red represents a louder volume; a lighter shade of red, closer to the color orange, represents a lighter volume. Size represents duration of sound—the bigger the shape, the longer the duration. Immediately after sketching this, it became clear how difficult this combination could be to understand. The hues being so similar would take the audience too long to understand, allowing them to quickly lose attention and interest.

Combines color, size, and opacity. Color represents type of sound, size represents volume, and opacity represents duration—darker opacity, longer duration; lighter opacity, shorter duration.

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<td>Volume</td>
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<th>Type</th>
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STUDY G

STUDY H

<table>
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<th>Type</th>
<th>Shape</th>
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<tr>
<td>Volume</td>
<td>Hue</td>
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Investigates color, line, and size for encoding the chosen variables. Color is used to represent type of sound. Line represents volume. Like in study A, where volume gets louder, the line produces a taller curved line, quieter noises produce smaller curved lines. Size of the circle indicates duration of sound; the bigger the circle, the longer the sound lasts. This combination has a lot happening with the visual and could quickly cause confusion among the user. While it may look visually appealing, it is hard to compare the types of sounds. If this were an interactive visualization, the user would not only have to watch the circle as it fluctuates from small to larger sizes, they would also need to watch the volume as it changes with each sound, which would be a lot for the user to focus on and comprehend.

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STUDY I
Since volume, duration, and type of sounds are constantly changing, all of these studies would be most effective shown in an interactive form but some are easier to comprehend than others. Taking my nine studies, I conducted user testing seeing which study was most appealing and easiest for potential users to understand. The grand consensus determined that study G was most appropriate for visualizing the three chosen variables but suggested opacity change to pulse to represent duration since this would be used in an interactive visual. Selecting one recording from my North End recording sessions I applied study G to visualize my sound variables.

Completing my data collection, I created an interactive sound map of the North End. The image on the right displays this map I created as an example for map designers to understand how sensory data, in this case sound, can apply to maps we use today.

Since volume, duration, and type of sounds are constantly changing, all of these studies would be most effective shown in an interactive form but some are easier to comprehend than others. Taking my nine studies, I conducted user testing seeing which study was most appealing and easiest for potential users to understand. The grand consensus determined that study G was most appropriate for visualizing the three chosen variables but suggested opacity change to pulse to represent duration since this would be used in an interactive visual. Selecting one recording from my North End recording sessions I applied study G to visualize my sound variables.
In completion of my variable studies, I was ready to enter the final stages of my sound map—creating an interactive sound map for people to experience the North End through its soundscape. Using JavaScript, my map was able to come to life—an interactive map enabling users to click on various locations and hear the sounds recorded in that spot. Not only do the recordings play, a visual inspired by study G appears—circles fading in and out as the sounds they represent appear in the recording. Users are also able to manipulate the visual by choosing from a specific category of selected sounds as well as playing all locations visuals at once.

With this interactive map people are empowered to understand the North End from a new light—it is no longer exclusively about what they see but what they hear. The sound translating to the user affords them a new outlook—a way of evaluating the area without being distracted by all of the pictorial storefronts, surreptitious people, and cars chaotically passing by. They are required to take a minute and listen, absorb, understand. For mapmakers, creating these maps mean we have empowered people to attend places through a new form—altering the typical way of understanding place and deterring from the norm. We have provided them with an enriched, stimulating, and engaging map.

The map above displays the interactive sound map with the display panel open. This panel allows users to view and compare all sound visuals at all locations, as well as compare a specific sound category at all locations. The user is also able to toggle from street view to satellite view for more context.
Opposite: Interactive Sound Map
With Visualizations
2016

Top: Interactive Sound Map
Bird sound category visualized
2016

Bottom: Interactive Sound Map
Transportation sound category visualized
2016
CONCLUSION

LOOKING FORWARD
Does incorporating other sensory experiences into spatial maps enhance our experience? Through the results of research, case studies, and a personal investigation—this guide has demonstrated the value of such an exploration.

There are important steps a map designer must take in order to execute a sensory map successfully, and this guide can be used as a framework to help with the process. In the near future I plan to apply this structure to the remaining three variables not yet studied: taste, touch, and smell, as well as providing code and defining an outline for making these visualizations interactive pieces.

Interaction is a way to engage and add greater dimensions to these maps, enhancing the experience for the user. But these maps don’t necessarily need to be interactive. Kate McLean’s static smell maps show a first step in creating a powerful experience for the user by allowing them to interact and engage in a way very different than most maps. For the sake of creating sensory stimulating maps however, it is important to have an interactive component where the viewer is physically able to interact and engage their senses while exploring these maps. Whether it be tasting the visualization through transparent mist, or smelling the data through a scratch and sniff platform. There are many ways to enrich the mapping experience.

While conducting my sound studies in the North End I was able to experience and understand the importance of the soundscape just as the visually impaired woman experienced the Boston transit soundscapes. All of those tinkering noises captured the identity of each place—construction where the North End was improving its infrastructure, birds where parks and calmer places reside, chaotic cars on popular streets. I was able separate the more residential areas from the touristy spots, navigate to a quiet space to read, or a busy street to people watch. Adding this layer of experience to a map completely changes the way one understands and interacts with a place. It allows the viewer to experience place from a new perspective, provoking curiosity about what makes a place so special, how important those tinkering noises of the bustling city are to us, and the effect they have on the way we think about, appreciate, and intermingle with the place.
INTERVIEW WITH KATE MCLEAN
Hopkins: How did you get into smell mapping?

McLean: I was studying for an MFA in Graphic Design at Edinburgh College of Art and was deconstructing the city into 5 separate sensory maps. This came from an outsiders’ point of view, trying to make sense of where I was and appreciating the elements of the city over the obvious. I started with touch, translating the city’s different districts into physical textures that I then blind printed using a process known as collography. I then leapt sideways and considered how the other senses might be mapped.

Hopkins: What is your system for collecting data?

McLean: The system involves the best recording device that humans have—the nose. My methodology is to use the smellwalk in one form or another to collect human-perceived data. I am interested in the qualitative elements of the smellscape and how we interpret, describe and portray them. I prefer to have residents do the smellwalks as they are best placed to know what they are smelling. If I do it I can add in my own values and external knowledge that might not be appropriate. Because we often cannot see the smells we rely on prior knowledge to be able to name them.
Hopkins: What is your system for visualizing small variables? How did you come up with this system?

McLean: That's easy but complex. I like to ‘measure’ the smell name, identify a source, and list two variables; perceived intensity and perceived duration. From that I attribute a smell a colour and then create a series of concentric rings to represent the intensity and duration. I then take all this and place it on a ‘map’ and move the shape based on wind speed and wind direction for the days that the data has been collected. I repeat this with every smell that I choose to include. Sometimes the maps are motion graphics, other times they are static.

Hopkins: Do you believe our senses can enrich maps and the mapping experience? If so, how?

McLean: Our senses make our mapping experiences. As smellwalkers move around the city they are slowly mapping the city; the notion of map as ontological goes, and instead the map is ontogenetic, creating realities as we move along it. I’ll get back to you with a little more here… I’m just off to catch a train to run Paris marathon ;)

Hopkins: How do you think smell can help us understand place better?

McLean: One of the main ways in which smells help to understand place better is enabling a new interpretation and a revisiting of places that we once thought that we knew… the smaller, hidden, ephemeral, transitory, volatile, nuances are revealed as we learn presence in the present.
NOTES
INTRODUCTION
3 Howes 2005: 143

INCENTIVE
1 Designmind.frogdesign.com/2014/05/beyond-data-visualization-experiencing-data-senses/
2 Mentealmodels.princeton.edu

SENSORY EXERCISES
1 www.nytimes.com

CASE STUDY 1
1 Theatlantic.com/technology/archive/2010/10/how-to-make-your-own-scratch-and-sniff-map/64106/
2 Thalys.com
3 Theinspirationroom.com

CASE STUDY 2
1 Sensorymaps.com

CASE STUDY 3
1 www.ora.systems
2 Atlasofthefuture.org

EXPLORATION 2
1 Geography.wisc.edu/faculty/roth/publications/roth_2015_EG.pdf
BOOKS


Gis.icao.int/icaoetod/map_projections[1].pdf 


ONLINE

Amyradcliffe.co.uk/Scent-ography-a-post-visual-past-time-1 

Atlasofthefuture.org/project/pala-peter-crnokrak 


Brianhouse.net/orki/siquotidian_record 

Designmindfrogdesign.com/2014/05/beyond-data-visualization-experiencing-data-senses 

Ediblegeography.com/youarehere 

Geography.wisc.edu/faculty/hoth/publications/Roth_2015_EG.pdf 

Herpackinglist.com/2014/01/sharing-your-story 

Lohiickick.com/488638/city-navy 

Miriamsimun.com/ghostfood 

News.berkeley.edu/2015/09/24/small-navigation-grant 

News.berkeley.edu/2015/06/17/small-navigation 

Orasystems 

Science.museum.org.uk/WhoAmI/FindOutMore/Yourbrain/Whatareyoursenses/Howdoyouselectinformation.aspx 

Sensoryjourneys.net 

Sensorymaps.com 

Ted.com/playlists/138/adventures_in_mapping 

Thalyss.com 

Theatlantic.com/technology/archive/2010/10/how-to-make-your-own-scratch-and-sniff-map/64106 

Theinspirationroom.com/daily/2015/thalyss-sounds-of-the-city
Mapmaking, an extremely evolved field, is a predominately visual sensory experience. What if we invited map designers to incorporate sensescapes into maps to allow for more engagement, creating a richer interactive experience. The following investigation, based on a series of case studies and experiments, is meant to serve as a prospective guide to empower map designers to think about maps and mapmaking in different sensory ways. Through understanding the richness of combining sensory data with spatial representation, we can shape new kinds of knowledge and experiences.

This premise was designed and writted by Jessica Hopkins