CHATTY MAPS

PRESS RELEASE

Urban sound has a huge influence over how we perceive places. Urban planners and city officials have mostly focused on the negative side of urban sounds, giving little attention to pleasant sounds. Yet, positive sounds have been shown to positively impact city dwellers' health.

That is why four researchers - Daniele Quercia, Luca Maria Aiello, Rossano Schifanella, and Francesco Aletta – have recently proposed a new way of capturing the whole spectrum of urban sounds at scale using social media data. First, the researchers collected smell-related words from Freesound, which is the largest public online collaborative repository of audio samples. They then collected geo-references pictures tagged with those words. To categorize sounds into coherent categories (e.g., talking and laughing), they counted the number of co-occurrences of those words in a large photo corpus from Flickr, with the hypothesis that if two words often co-occur they belong to the same category. With this assumption, they run an algorithm to automatically detect clusters of words often occurring together, and they produced the first urban sound dictionary. In it, sound words are classified into six main categories: transport (e.g., motorcycle, locomotive, aircraft, engine), nature & animals (e.g., chirp, barking, raining), human (e.g., footsteps, talking, sneezing, laughing), music (e.g., guitar, flute, cello), mechanical (e.g., jackhammer, compressor), indoor (e.g., showering, toilet flushing).

For a variety of cities around the world, they then extracted the public geo-tagged textual social media content (for example, the tags of geo-referenced pictures from Flickr) and associate them with each street segment to compute a sound profile of the segment. Interactive maps for 12 cities (London, Barcelona, Madrid, New York, Boston, Chicago, Washington, Miami, San Francisco, Seattle, Milan, Rome) are available at http://goodcitylife.org/chattymaps.

By then looking at emotion-related picture tags, the researchers found that human-related sounds (e.g., talking, sneezing, laughing, screaming) tended to

be associated with joy or surprise picture tags. Musical instruments (e.g., guitar, flute, cello) with joy, sadness, or both (melancholy). Traffic and mechanical sounds (e.g., motorcycle, locomotive, aircraft, engine, jackhammer, compressor) are associated with anger or fear. Last, sounds coming from households (e.g., showering, toilet flushing) or places of worship (e.g., bells, organ) were associated with trust.

Urban sound can also be soothing, exhilarating, saddening, and surprising. Using a statistical analysis of people's reactions to different sorts of urban sound, the researchers drew up four broad categories: chaotic, calm, monotonous and vibrant. Not surprisingly, parks sound calm. More surprisingly beaches (at least, those in Barcelona) are monotonous. But, main roads aside (they are usually chaotic) a stranger to either city would have difficulty predicting from a map which streets would have good vibes and which would seem chaotic.

The ultimate goal of this work is to empower city managers and researchers to find solutions for an ecologically balanced soundscape.

FAQ

What was the purpose of this study and what do you hope the results will help achieve?

Urban sound has a huge influence over how we perceive places. Studies have found that long-term exposure to urban noise results into sleeplessness and stress, increased incidence of learning impairments among children, and increased risk of cardiovascular morbidity such as hypertension and heart attacks. For this reason, urban planners and city officials have mostly focused on the negative side of urban sounds, giving little attention to pleasant sounds. Yet, positive sounds have been shown to positively impact city dwellers' health. With the Chatty Maps project, we capture the whole spectrum of urban sounds at scale using social media data. Also, for the first time, we systematically associate sounds with the emotions they arouse (e.g., joy, anger, sadness) and with how people perceive them (e.g., vibrant vs. monotonous sounds).

The ultimate goal of this work is to empower city managers and researchers to find solutions for an ecologically balanced soundscape where the

relationship between the human community and its sonic environment is in harmony.

How was the idea for the research conceived?

Our research has been focusing on how people psychologically perceive the urban environment, and on how to capture that in a quantitative fashion. To that end, last year, we designed a mapping tool (known as "Happy Maps") that returns not only the shortest direction from A to B but also the short directions that are emotionally pleasant (see http://www.wired.com/2014/07/we-need-this-a-maps-app-that-algorithmically-finds-you-the-scenic-route/). During trials of that work, participants loved the pleasant directions but also expressed the need to integrate other senses into the recommendation process. We first looked at the olfactory perception (see the "Smelly Maps" project at http://goodcitylife.org/smellymaps/project.html) and we later explored the auditory dimension.

Did any of the results surprise you? What was the most unexpected finding, in your own opinion?

Urban sound is not only annoying but can also be soothing, exhilarating, saddening, and surprising. Using a statistical analysis of people's reactions to different sorts of urban sound, we drew up four broad categories: chaotic, calm, monotonous and vibrant. Not surprisingly, parks sound calm. More surprisingly beaches (at least, those in Barcelona) are monotonous. But, main roads aside (they are usually chaotic) a stranger to either city would have difficulty predicting from a map which streets would have good vibes and which would seem chaotic.

What was the inspiration behind the work?

The project was largely inspired by the work done by composer R. Murray Schafer who led in the 70s the "World Soundscape Project", an international research initiative that gave birth to the modern study of acoustic ecology. In his book "The Soundscape", Schafer coined the term "soundscape" and emphasized the importance of identifying pleasant sounds and using them to create healthier environments. He described how to classify sounds, appreciating their beauty or ugliness.

How the dictionary and the soundscape wheel were built?

First, we collated smell-related words from Freesound, the largest public online collaborative repository of audio samples. We then collected geo-references pictures tagged with those words. To categorize sounds into coherent categories (e.g., talking and laughing), we counted the number of co-occurrences of those words in a large photo corpus from Flickr, with the hypothesis that if two words often co-occur they belong to the same category. With this assumption, we run an algorithm to automatically detect clusters of words often occurring together, and we found that the emerging clusters striking resemble the smell categories from the literature (for example, the categorization offered by Schafer in his book "The Soundscape").

Any example of sounds-related words?

We have found six main sound categories: transport (motorcycle, locomotive, aircraft, engine) nature & animals (chirp, barking, raining), human (footsteps, talking, sneezing, laughing), music (guitar, flute, cello), mechanical (jackhammer, compressor), indoor (showering, toilet flushing).

Since our analysis considers not only London but also Barcelona, we also manually translated the terms into Spanish. By visual inspection, one sees that all the words in the dictionary are all related to the domain of sound.

In simple terms, how does the map work?

The main idea behind our method was to search for sound-related words (mainly words reflecting potential sources of sound) on geo-referenced social media content. For each city, we can extract the public geo-tagged textual social media content (for example, the tags of geo-referenced pictures from Flickr) and associate them with a street segment, as identified by OpenStreetMap (a free, crowdsourced online mapping tool). By processing the geo-referenced words that match the terms in the sound dictionary we compute a sound profile of the street that expresses the intensity of the 6 main sound categories (transport, nature, human, music, mechanical, and indoor sounds) in that street.

How human emotions are related to the different sounds categories?

Sounds can be classified according to their emotional qualities. To extract emotions from textual content we use Emolex a word-emotion lexicon that maps 6,468 terms with 8 primary emotional responses (anger, fear,

anticipation, trust, surprise, sadness, joy, and disgust) come from Plutchik's psychoevolutionary theory (https://en.wikipedia.org/wiki/Contrasting_and_categorization_of_emotions#Plutchik.27s_wheel_of_emotions). We match the Emolex terms with the tags of Flickr geo-referenced pictures and we look at the correlation between and create an emotion profile of the street. By correlating the emotion profile with the street sound profile we find insightful associations. Human-related sounds (e.g., talking, sneezing, laughing, screaming) tend to be associated with joy or surprise. Musical instruments (e.g., guitar, flute, cello) trigger joy, sadness, or both (melancholy). Traffic and mechanical sounds (e.g., motorcycle, locomotive, aircraft, engine, jackhammer, compressor) are associated with anger or fear. Last, sounds coming from households (e.g., showering, toilet flushing) or places of worship (e.g., bells, organ) are associated with trust.

Is the soundscape related to people's perceptions and how did you study this relationship?

Surely sounds can be also described according to the way they are perceived by people. From our social media data, we knew the extent to which a potential source of sound was present on a street. If we knew how people usually perceived that source as well, we could have estimated how the street was likely to be perceived. One way of determining how people usually perceive sounds in the city context is to run soundwalks. We conducted soundwalks across several areas in Brighton & Hove (UK) and Sorrento (Italy) where participants were asked to listen to the acoustic environment, to record on a questionnaire the sounds they heard and to categorize them into a 8-dimensional characterization of sound perception i.e., how much a sound is pleasant, chaotic, vibrant, uneventful, calm, annoying, eventful, or monotonous. By parsing the survey results we were able to estimate the probability of occurrence of each of the 8 perception types given the presence of a certain sound. This simple probabilistic model can be easily scaled: to map how streets are likely to be perceived, we can similarly estimate a street's expected perception given the street's sound profile. Streets with sounds of people and crowds tend to be perceived as vibrant, pleasant and eventful, whereas trafficked streets as annoying and chaotic.

Any example of maps?

Interactive maps for 12 cities (London, Barcelona, Madrid, New York, Boston, Chicago, Washington, Miami, San Francisco, Seattle, Milan, Rome) are

available at http://goodcitylife.org/chattymaps. Static images of the maps and of the sound wheel are also provided on the project page.

How did the four of you come to work on it together?

Daniele, Rossano and Luca are all computer scientists who conduct their research around social media data. They have been working together in the area of urban informatics for more than two years. For this work they teamed up with Francesco, an architect who does research on urban soundscapes and conducts soundwalks to study the perceptions that people have of sounds.

How do you plan on following up the study?

As researchers, we're fascinated by urban studies and the way we can improve people's experiences in our cities. One can imagine a variety of practical applications. New way-finding tools might well suggest not only shortest routes between points but also short ones that are auditory pleasant. More generally, our methodology allows for the development of new tools to map urban soundscapes. Urban planners could go beyond the attempt of mitigating noise and its potential negative impact and could use, instead, social media tools to monitor the whole spectrum of emotion associated with the soundscape. This might inform policies to incentivize the development of areas with pleasurable sounds. In the future, we will conduct a comprehensive multisensory research of cities, one in which visual, olfactory, and sound perceptions are explored together.

Will an app be available to the public?

Maps of 12 cities are browsable at http://goodcitylife.org/chattymaps. More will be available in the future. This is a research project; a release of a commercial application is not planned.

<u>Important notes for editors:</u> The Chatty Maps project involves Daniele Quercia (Bells Labs, UK), Rossano Schifanella (University of Turin, IT), Luca Maria Aiello (Yahoo London, UK), Francesco Aletta (University of Sheffield, UK). In any news article covering this research, a link to this site http://goodcitylife.org might be beneficial. Also, please keep the OpenStreetMap, CartoDB, MapBox attributions of the original maps.