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Digital Object Identifier (DOI)

<https://doi.org/10.1068/a44674>

Notes/Citation Information

Published in *Environment and Planning A: Economy and Space*, v. 45, issue 1, p. 77-99.

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Augmented realities and uneven geographies: exploring the geolinguistic contours of the web

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Received 9 December 2011; in revised form 15 March 2012

Abstract. This paper analyzes the digital dimensions of places as represented by online, geocoded references to the economic, social, and political experiences of the city. These digital layers are invisible to the naked eye, but form a central component of the augmentations and mediations of place enabled by hundreds of millions of mobile computing devices and other digital technologies. The analysis highlights how these augmentations of place differ across space and language and highlights both the differences and some of the causal factors behind them. This is performed through a global study of all online content indexed within Google Maps, and more specific analyses of the linguistically and topically segregated layers of information over four selected places. The uneven linguistic geographies that this study reveals undoubtedly influence the many ways in which place is enacted and brought into being. The larger aim of this project is to use these initial mappings of the linguistic contours of the geoweb to push forward a broader debate about how augmented inclusions and exclusions, visibilities and invisibilities will shape the way that places become defined, imagined, and experienced.

Keywords: augmented reality, neogeography, volunteered geographic information, place, Internet

Introduction

The way in which understandings of places are constructed through depictions, names, and representations have long defined the meanings associated with our material environments (eg, Basso, 1996; Cresswell, 2009). Fixings of place in names, stories, songs, books, newspapers, videos, and other cultural media matter because those stabilizations, in turn, become the basis for how we understand, produce, reproduce, enact, and reenact the places and cities that we live in. Never before have so many representations of the meaning of places—either deliberate commentaries or offhand by-products of daily life—been so readily available for consumption and contestation. Due to the overwhelming wealth of depictions, however, there is a simultaneous process of software (eg, PageRank) and social-sorting systems (eg, online social networks) that prioritize and present a selective slice of the multitude of representations of places (Graham, 2005; Zook and Graham, 2007b). As a result, places are increasingly defined by dense and complex layers of representation that are created, accessed, and filtered via digital technologies and often opaque lines of coded algorithms (Graham, 2010; Kitchin and Dodge, 2011; Thrift and French, 2002).

This digital dimension to place is layered throughout our urban landscapes as geocoded references that trace economic, social, and political experiences of the city. These digital layers are invisible to the naked eye, but form a central component of the augmentations and

mediations of place enabled by hundreds of millions of mobile devices, computers, and other digital technologies (Graham, 2011a). In this paper we take up the term ‘augmented reality’ to refer to the “indeterminate, unstable, context dependent and multiple realities brought into being through the subjective coming-togethers in time and space of material and virtual experience, as illustrated in the opening passage. In other words: augmented reality is the material/virtual nexus mediated through technology, information, and code and enacted in specific and individualised space/time configurations” (Graham et al, 2012).

Beyond simply accessing and using these representations about place, individuals are actively adding, editing, and contesting this information. But, far from uniform and ubiquitous, these digital dimensions of places are fractured along a number of axes such as location, language, and social networks with correspondingly splintered representations customized to individuals’ unique sets of abilities and backgrounds. As such, the resulting constructions of place are complex and far from uniform across space, class, or culture.

This paper analyzes how these fractures differ across space and language both to highlight the differences and to initiate the process of explaining the factors behind them. This is performed through a combination of a global study of all content indexed in Google Maps, and more specific analyses of the linguistically and topically segregated layers of information over four selected places. While some of the disparities conform to longstanding offline patterns of information inequalities and uneven representations, others highlight the changing fortunes and positions of places in a globalizing economy and highlight the increasingly finer scale of differentiation in which understandings of places are constructed.

Uneven and selective information geographies of the web

Despite rhetoric to the contrary (Negroponte, 1995), the Internet and World Wide Web have not done away with the importance of geography (eg, Graham, 2011b; O’Kelly et al, 2006; Tranos, 2011) but, rather, have continuously been shaped by spatial constraints and resources (Zook, 2005). Beginning with the release of Keyhole Digital Earth (later acquired and rebranded as Google Earth) in 2004 and expanded via Google Maps in 2005 and innumerable map mashups and geo-apps, an ever increasing amount of online information is geotagged to material places. The resulting layering of online information over material places is generally referred to as the geoweb and has become increasingly central to many of the ways in which online information is used today.

Concurrent with the rise of the geoweb were two parallel phenomena—the rise of mobile services and user-generated information—which served to enhance the power and visibility both of the geoweb itself and of people’s ability to move through and enact hybrid virtual–material places (eg, Crampton, 2009; Goodchild, 2007; Haklay et al, 2008). High-speed mobile phone networks and mobile devices with rich graphical interfaces have recently enabled users to access geoweb references to the material place they inhabit while they are moving through it. In other words, many people now quite literally have access to much of the world’s codified information about places from the palms of their hands. This represents a watershed in terms of real-time interactivity between the dynamic experience and representation of places. This is further enriched by the growth of Web 2.0 applications (O’Reilly, 2005) which allow users not only to access information about places in situ but also to edit this information as they experience and change it.

This recent and rapid growth in both virtual representations of place and the technologies to access those representations calls for a clear assessment of the ways in which virtual representations of place, in conjunction with myriad digital and nondigital codes, layerings, and discourses, are implicated in the production and experiences of places as augmented realities. Digital representations of places are thus increasingly pushing material places (and their digital layers) to become more hybrid and unfixd (Lee, 2010).

As digital layers of geocoded content are increasingly intertwined in the construction of place, two central and linked concerns, about content availability and visibility, emerge. The first issue, of availability, is concerned primarily with questions of which places are being annotated and who is participating in this process. The second revolves around the mechanisms by which this content is created, chosen, sorted, and prioritized as a particular representation of place. The resulting depictions offered to users as they navigate through the hybrid landscapes of digital data and physical experience potentially offer new hyperfragmented and specialized experiences of place. The remainder of this paper now turns to address both of these issues.

Uneven digital annotations

The concern about authorship and content availability within visualization and representation of places builds upon longstanding critiques within cartography and social theory about the construction of spatial knowledge and the tendency to mask the constructed power of existing social orders as unbiased and objective (Pickles, 1995). In particular, maps emphasize selected elements of the social experience and in so doing present a commentary on what is important and what is not. As Harley (1989, page 7) argues, “Maps are authoritarian images. Without our being aware of it maps can reinforce and legitimate the status quo... Where it seems to be neutral it is the sly ‘rhetoric of neutrality’ that is trying to persuade us.”

The concern, therefore, is that as representations of geocoded digital content become increasingly important in how places are understood and enacted, certain populations and viewpoints could be largely shut out of these developing digital practices (eg, Haklay, 2010). In other words, building on Castells’s (2008, page 53) thesis that “power in the network society is communication power” there is a worrisome potential for the enactment of new forms of digital imperialism based on the knowledge dependence and inequality (eg, Ya’u, 2005) contained within these new maps. Internet content, sorting algorithms and platforms, and common online practices all serve to reinforce the visibility of the already highly visible, and make peripheral voices more marginal (Zook and Graham, 2007b). In other words, those capturing, recording, annotating, and representing place digitally exert a very real control and possession over those places (Elwood, 2008; Garlick, 2002). As Cresswell (2009, page 9) argues, “Naming is one of the ways space can be given meaning and become place” and the high density of augmentation in some places such as North America or Western Europe compared with a corresponding lack of reference in other places, such as sub-saharan Africa, echoes 19th-century maps with ‘interior unknown’ labels on central Africa.

The role of geocoded content in normalizing hegemonic ideas is, however, tempered by the reciprocal opportunities that new communication technologies offer to peripheralized people and places. As Castells (2008, pages 135–136) argues:

“The interactive capacity of the new communication system ushers in a new form of communication, mass self communication, which multiplies and diversifies the entry points in the communication process. This gives rise to unprecedented autonomy for communicative subjects ... while reflecting power relationships, [it] is not based on the top-down diffusion of one dominant culture. It is diverse and flexible, open ended in the content of its messages, depending on the specific configurations of business, power, and culture.”

In the context of the geoweb, Castells’s ‘mass self-communication’ is exemplified by the open tools and practices of new ‘citizen cartography’—also referred to as ‘neogeography’ or ‘volunteered geographic information’.

Although the terms vary, a central focus of most discussion of user-generated geocontent or neogeography tends uniformly to be on “people using and creating their own maps, on their own terms ... helping shape context, and conveying understanding through

knowledge of place” (Turner, 2006, page 3). Most importantly here, the increasing availability of geographically grounded and locally relevant content has the real potential to result in more representations and a greater amount of voice from traditionally marginalized people and places. In his early assessment of the potential for user-generated content about places, Goodchild (2007, page 220) notes that one of the important outcomes may be “what it can tell about local activities in various geographic locations that go unnoticed by the world’s media, and about life at a local level.” Indeed, as is discussed in Goodchild and Turner’s conversation that opens this theme issue (Wilson and Graham, 2013), there are distinct opportunities for user-generated geocontent to render local knowledge more accessible. As such, practices of technology and information usage which augment our material worlds with digital content could open up both a literal and a metaphorical space for more locally relevant information in the world’s peripheries and marginalized populations (Zook et al, 2010).

Mechanisms of selective prioritization

Concerns about the authorship of geocoded content lead directly into the second issue about mechanisms by which digital content about places is accessed and prioritized. Just as medieval European territorial maps help normalize socially constructed hierarchies such as “the contours of feudalism” or the “shape of religious hierarchy” (Harley, 1989, page 6), so digital representations of places have the same ability to reify understandings about the material environment.

The mechanisms for the prioritization of representations are multiple and begin with linguistic differences. This is achieved both through keyword matching (ie, linking a text string inputted by a user to content containing that same string), and through automatic language-detection filters that seek to return results based on the predicted language of the user based on searches. Language customization, however, is just the first step of this process of selective ranking, categorization, and software sorting (Graham, 2005).

For example, Google’s assemblage of algorithms (eg, the code embedded in their pagerank and placerrank tools) builds upon the interlinkages between information and interactions, so that more popular activities are prioritized and made more visible to users.⁽¹⁾ This process is largely hidden from viewers of these spatial representations, who are presented with a naturalized ranking of content which determines what content about a place can be seen (Zook and Graham, 2007a). For instance, the statement, placed on all searches in Google’s News search, that “the selection and placement of stories on this page were determined automatically by a computer program” deemphasizes the socially constructed nature of the links and content that are key inputs to the ranking presented and instead advances a rhetoric of coded objectivity.

Although spatial representations have been couched in ideas of coded objectivity, they are also increasingly (and paradoxically) brought into being by highly tailored and personalized services. Online search results are already influenced by one’s previous searches and preferences, language usage, and geographic location, and are increasingly tied to the preferences of one’s online social network. Pariser (2011) dubs these cocoons ‘filter bubbles’ and uses the example of a 9/11 conspiracy theorist searching for information on the World Trade Center attacks and then only receiving content that supports his/her views. In other words, a combination of the rhetoric of coded objectivity of algorithmically

⁽¹⁾For example, when Google first deployed the Google Favorite Places program in 2009, it sent a selection of business individualized QR window decals. The selection of this group was based upon “the popularity of a business’ Google Places listing, as determined by how many times Google users looked for more information about a business, requested driving directions to get there, and more. Google users ‘decided’ based on their actions, and we sent the decals” <http://www.google.com/help/maps/favoriteplaces/business/faq.html#>

ranked maps, alongside active targeting, and customization of search, brings into being a representation of the world which reinforces much of what is already believed, serving to reinforce Pariser's filter bubbles. Geocoded content is thus increasingly fragmented into individualized representations that ultimately enable the construction of self-reinforcing information cocoons.

These two broad concerns of uneven augmentation/authorship and selective visibility lead to important questions about the content in the geoweb overlaying our world. Building upon the first issue—the variegated geographies of content—in this paper we ask: what are the geographies and densities of augmentations of material places? Second, to address concerns about visibility and filter bubbles, we build on debates about the customization of information by examining the linguistically segregated layers of digital augmentations for a selection of languages and subjects. More specifically, we ask, via a series of case-study locations: what are the spatial footprints of different languages in the geoweb? Of particular interest is the extent to which geocoded content is available in local languages versus the *lingua franca* of English, as well as how content in different languages augments the same places in fundamentally different ways.

Locating language on the geoweb

In order to answer the above questions, this paper draws on the field of geolinguistics and uses the notion of geolinguistic region to understand the audiencing of online content [see Albizu (2007) and Liao and Petzold (2010) for similar approaches]. For the purposes of this paper, a geolinguistic region is defined as a contiguous area in which a dominant language⁽²⁾ is employed for communication or representation. Geolinguistic contours are, then, the boundaries of those regions. While geolinguistic regions and contours are necessarily contested, complex, and unstable, it is nonetheless useful to discuss and study the broad contours of language use in order to better understand the production, reproduction, audiencing, and representation of information and place. Liao (2011, page 2) notes that “to be heard, one has to speak the language of an audience”, and, as such, it is important to understand the geographies of geolinguistic regions at a range of scales [a point echoed by van der Merwe (1993)].

While geoweb content comes in a number of forms, this paper focuses exclusively on content indexed in the Google Maps search engine. Google Maps is useful in the context of these research questions because it is (1) the first point of entry for many Internet users accessing local information, and (2) a platform that includes a diverse range of content types. The Google platform brings together a huge amount of indexed, volunteered geographic information, including submitted business content, Yellow Pages information, user-generated reviews, comments, photos, placemarks, and other geolocatable web content, making it arguably the most comprehensive interface to the geoweb. Given the amalgamated nature of this information layer, however, it is impossible to trace the myriad factors that lead to the amount of content indexed at any given location. Policy decisions within Google Maps, availability of digitized directory information, and the proclivity of users to contribute content all contribute to the density of the geoweb at any point. Nevertheless, the data reflect what users of Google Maps encounter and therefore provide important insights on the shape and nature of the differences between places and across languages within the same place.

The paper employs a method of mapping online content which has previously been discussed in more detail (Graham and Zook, 2011). In order to measure language in the geoweb, a grid of longitude and latitude coordinates was created for a selection of regions including Belgium, Spain, France, Canada, Kenya, the UAE, India, and Israel and the

⁽²⁾This does not exclude the possibility of there being multiple dominant languages in a place. For instance, Kiswahili and English might be considered to be dominant languages in Nairobi (in contrast to Kikuyu, Luo, Kamba, or the many other languages spoken in that part of the world).

Palestinian Territories. These regions were selected to provide a range of cases with diverse language use and a range of socioeconomic conditions. Although the initial set of locations included several non-Western locations, the density of geocoded content indexed by Google in the UAE, Kenya, and India was too low for meaningful analysis of linguistic differences. The results for these regions do, however, aptly demonstrate the unevenness of geocoded content around the world.

The spacing of the grid points varied depending upon the size of the territory, ranging from half a mile to one mile, and to ensure that the entirety of the region was captured the grid was extended into neighbouring countries. At each set of grid coordinates, an automated and customized script was employed to run searches for (1) the total amount of content indexed at a place, and (2) a selection of keywords in the languages spoken within the region, as well as (3) the lingua franca of English (see figure 1). All searches were submitted to the Google.com interface to limit possible variation due to localized versions of Google—Google.be, or Google.fr—although cross checks between the global and local versions of Google showed identical results. Searches were conducted in June and July of 2011 and the number of ‘hits’ at each grid point and search-term combination was collected.

English	Arabic	Bengali	Castilian	Catalan	Dutch	French	German
love	حب	ভালোবাসা	Amor	Amor	liefde	amour	Liebe
restaurant	مطعم	সাম্বারণ ভোজনালয়	Restaurante	restaurant	restaurant	restaurant	restaurant
sex	جنس	স্বী-পুরুষ ভেদ	Sexo	Sexe	Sex	Sexe	Sex
god	الله	দেবতা	Dios	Déu	God	Dieu	Gott
democracy	ديمقراطية	গণতন্ত্র	democracia	democràcia	democratie	démocratie	Demokratie
war	حرب	যুদ্ধ	Guerra	Guerra	Oorlog	Guerre	Krieg
internet	إنترنت	ইন্টারনেট	Internet	Internet	internet	internet	Internet
Muslim	مسلم		Musulmán		Moslim	musulmans	Muslim
Christian	مسيحيون	খ্রিস্টীয়	cristiana	cristiana	Christen	Christian	Christ
Jewish	يهودية	ইহুদি আভীয়	Judaísmo	Judaïsme	Jodendom	Judaïsme	Judentum
Hindu	هندوسية	হিন্দু	Hindú	hindú	Hindoe	hindou	Hindu
Government	حكومة	সরকার	gobierno	Govern	Regering	Gouvernement	Regierung
Wedding	زفاف	বিবাহ	Boda	Casament	Bruiloft	Noces	Hochzeit
Tax	ضريبة	কর	Tasa	Impost	Belasting	Impôt	Steuer
Flu	إنفلونزا	ইনফ্লুয়েন্স	gripe	grip	griep	grippe	grippe
Monkey	معدان	মানর	mono	mico	aap	singe	affe
Music	موسيقى	সংগীতবিদ্যা	Música	Música	Muziek	Musique	Musik
Cat	قط	বিড়াল	gato	gat	Kat	Chat	katze

Hebrew	Hindi	Kiswahili	Marathi	Russian	Tamil	Telugu	Urdu
אהבה	प्यार	Pendo	प्रेम	любовь	அன்பு	ప్రేమ	محبت
המסעדה	हॉटेल	mgahawa	उपहारगृह	ресторан	உணவகம்	ఆహారశాల	رستوران
סקס	लिंग	ngono	कामजीवन	секс	பால்	రతి	جنس
אלהים	ईश्वर	Mungu	देव	Бог	கடவுள்	దేవుడు	معبود
הדמוקרטיה	लोकतंत्र	Demokrasia	लोकशाही	демократия	மக்களாட்சி	ప్రజాస్వామ్యం	جمہوریت
המלחמה	संघाम	Vita	युद्ध	война	போர்	యుద్ధం	جنگ
הממשלה	अंतरजाल	Intaneti	इंटरनेट	Интернет	இணையம்	అంతర్జాల	جنگ
המוסלמים	मुसलमान	Mwislamu	मुसलमान	Мусульманин	ரவை சல்லா	అంబర్కాట్	مسلم
הצלבנים	ईसाई	Christian	ख्रिस्तसंबंधी	Христианин	கிறிஸ்துவ மதஸ்தர்	క్రైస్తవుడు	عيسائي
יהודים	यहूदी धर्म	Uyahudi	यहूदी लोकाय	Иудаизм	பூதம்	బహాయిజం	يهودي
הינדואיזם	सनातन धर्म	Hindu		Индус	து மதத்தைச் சார்ந்தவர்		ہندو
המשמלה	सरकार	Serikali	शासन	правительство	அரசு	ప్రభుత్వం	حکومت
התחתונה	शादी	Harusi	लग्न करणे	Свадьба	திருமணச்சடங்கு	వివాహం	شادی
הסכסוך	कर	Kodi	कर	налог	வரி	పన్ను	ٹیکس
התפוצה	नज़ला	mafua	सर्दी	Грипп	இன்ஃபுளுவென்சா	పూ	ظفر
הקט	वंदर	nyani	माकड	Обезьяны	குரங்கு	కీటి	بندر
הקמיקה	संगीत	Muziki	संगीत	Музыка	இசை	ఛారిత్రయ సంగీతము	موسیقی
החתול	बिल्ली	paka	मांजर	кошка	பூனை	పిల్లి	بلی

Figure 1. Keyword terms used.

It is important to note that the counts or number of hits returned from these searches refer to the number of places containing relevant content, rather than the number of documents referencing places. In other words, a place (this could be a shop, monument, street, park, etc) could have many reviews, photographs, placemarks, and other digital content layered over it, but would only count once in the results. This is, unfortunately, an insurmountable barrier associated with our data source. As such, we are careful to interpret the results as providing insights into the *amount of places* indexed and the *types of content* indexed about those places, rather than a comprehensive measure of all content indexed about those places.

Due to the inability to measure the total amount of any given language georeferenced to a point—Google Maps does not provide a publically accessible language filter—a series of eighteen words that are both significantly different in multiple languages (ie, are defined nonoverlapping combinations of characters), and represent a diversity of topics, was selected. These specific words and the meanings, places, and things they represent are less important than their role as an indicator of the geolinguistic contours of a place. In other words, the number of hits for the keyword ‘love’ or ‘music’ does not necessarily reveal much about the representations of either love or music in a place, but does act as a rough proxy for language use, especially when compared with the relative number of hits for the same keywords in another language. A complete list of languages and keywords employed are compiled in figure 1, although searches in the case-study locations were only conducted in the languages spoken locally. During the analysis phase, close attention was paid to cases in which a word had any overlap with a widely used word in another language. The word ‘war’ in English, for instance, also means ‘was’ in German and thus was excluded in any places where the two could be confused.

Although the resulting datasets are large (the work discussed in this paper is based on observations at approximately 400 000 coordinates, spaced roughly half a mile apart), the samples, keyword selection, and case studies are both temporally and spatially limited. Despite these limitations, however, the geographies of content visible in these samples provide key insights into the geolinguistic contours of the digital content that augments our world. The contours of these neogeographies are undoubtedly shifting and unstable but, through close examination of the augmentations mediated by one of the planet’s largest open portals of geographic information, we are able to interrogate whether we are seeing fundamentally new geographies of geographic information or, rather, virtual mirrors of earlier power geometries.

Geographies of uneven digital augmentations

This section addresses the paper’s first research question: what are the geographies and densities of augmentations of material places? The use of the word ‘density’ in this paper refers to the quantity of information layered over (or augmenting) a place. Such layers of information are necessarily always in flux, and their construction, configuration, and even existence is often contingent on individual positionalities. However, by mapping the densities of information that augment our planet, we are able to broadly understand which parts of the world lack digital layers of representation.

A simple way to gauge the density of geoweb content is to map the amount of material per capita indexed by Google Maps for every country in the world (see figure 2). This visualization clearly demonstrates that Western Europe and North America are characterized by the highest amounts of augmented content per capita (see also table 1): with much of the rest of the world covered by only a sparse amount of information. Indeed, most of Africa, the Middle East, Central America, and Central Asia fall far short of the global average of 13.1 hits per capita: for example, Afghanistan only has 0.03 hits per person and the entire continent of Africa has less indexed content than the Tokyo metropolitan region.

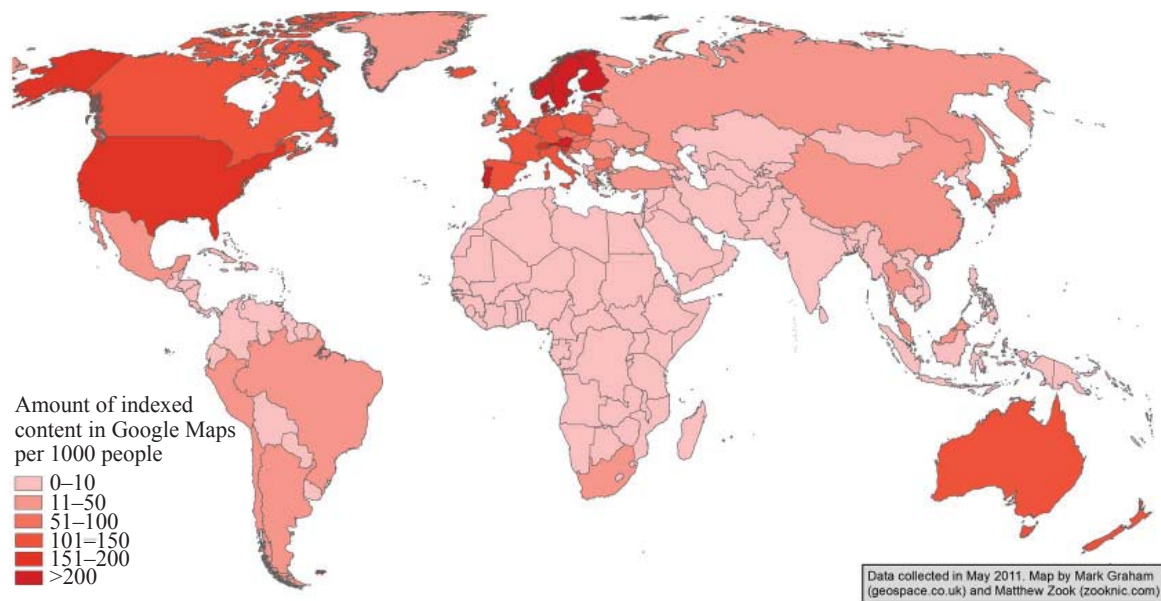


Figure 2. [In color online.] Global map of indexed geoweb data per capita.

Table 1. Top twenty countries for indexed geoweb data per capita.

Rank	Country	Geoweb per capita (thousands)	Geoweb per Internet user (thousands)	GDP (PPP) per capita
1	Norway	434.16	506.69	84 444
2	Finland	393.97	496.18	44 489
3	Sweden	379.78	441.10	48 875
4	Portugal	296.06	264.15	21 559
5	Denmark	255.39	303.44	56 147
6	Estonia	230.00	349.69	14 836
7	Austria	210.35	308.31	44 987
8	Luxembourg	165.52	223.68	108 832
9	Slovenia	164.30	310.64	23 706
10	United States	156.36	216.37	47 284
11	Switzerland	150.36	199.22	67 246
12	France	146.83	297.64	41 019
13	Germany	145.83	192.10	40 631
14	Australia	143.52	240.29	55 590
15	Netherlands	135.59	158.50	47 172
16	Spain	130.46	201.80	30 639
17	Iceland	130.34	157.80	39 026
18	New Zealand	128.92	185.71	32 145
19	Canada	128.64	179.49	46 215
20	Italy	116.82	212.20	34 059

These current patterns mirror many of the geographic patterns evident in the early days of the web, indicating that arrangements of online cores and peripheries have perpetuated, albeit imperfectly. For example, Zook's (2001) analysis of domain-name density in 1999 revealed the same types of disparities between developed and developing countries and he noted that over 85% of the world's domain names were located within Europe and North America. Moreover, the same pattern of dense concentrations within Nordic and other small European countries shown in table 1 is extremely reminiscent of domain-name densities observed in

1999 (Zook, 2001; table 1). It is likely that the same advantages of relatively small populations and a proclivity towards early adoption of new innovations within information technologies are tied to this pattern.

At the same time, there are marked differences from the earlier pattern: most notably, the geoweb per capita densities for Japan (74.6 hits per capita), South Korea (75.2), and China (23.6), which are much higher relative to their level of domain-name use in 1999. Japan stood out with the lowest per capita domain-name density for OECD countries (Zook, 2001), reflecting both the largely English-oriented Internet system at that time as well as a preference for mobile phones rather than computers with keyboards optimized for Western alphabets (Aoyama, 2000). In 1999, China had thousands of fewer domains per capita than European countries, a metric exacerbated by China's large (and at that time predominately offline) population. Thus, the relative higher densities observed in 2011 show both the vast increase in Internet use (particularly in the case of China) as well as advances in making it easier to use non-Western characters in Internet applications.

Thus, the current geographies of augmentation of material places reflects the legacy of North America and Western Europe in Internet use during the 1990s, but also highlights the increasingly strong tie with socioeconomic status. For example, there is a significant and positive correlation (0.48) between per capita GDP of a country and its amount of geoweb content per capita (see figure 3).⁽³⁾ This correlation has a number of outliers, such as early adopters of the geoweb who are relatively low income (such as Estonia) as well as well-off countries with relatively little indexed geoweb content (for example, Qatar and the UAE).

However, analyzing and visualizing content aggregated at the country level conceals many important subnational variations in content. Zook (2001, page 1685) documented that the top-100 metropolitan concentrations of domain names contained more than half of the world's Internet domains in 1999. To examine this question, figure 4 shows an inverse distance weighting interpolation of data from a quarter of a million points (separated by quarter of degrees) at the global scale. This image indicates that the indexed geoweb content

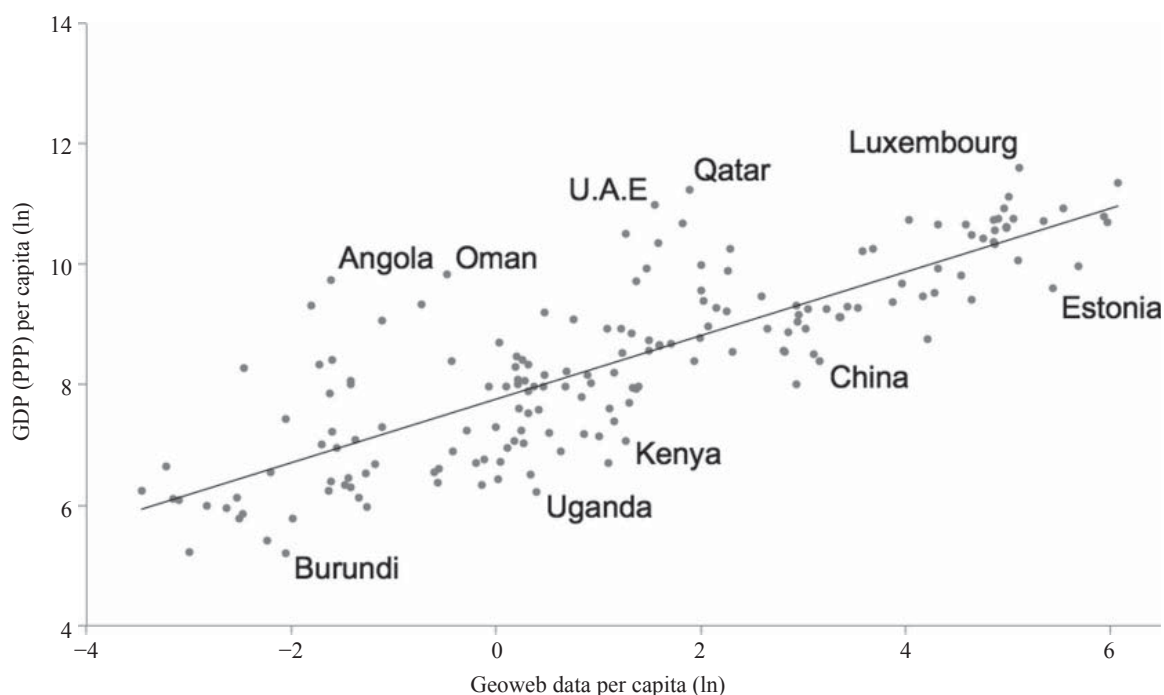


Figure 3. Scatterplot of indexed geoweb data versus GDP per capita.

⁽³⁾All GDP data were obtained from the IMF and are for 2010.

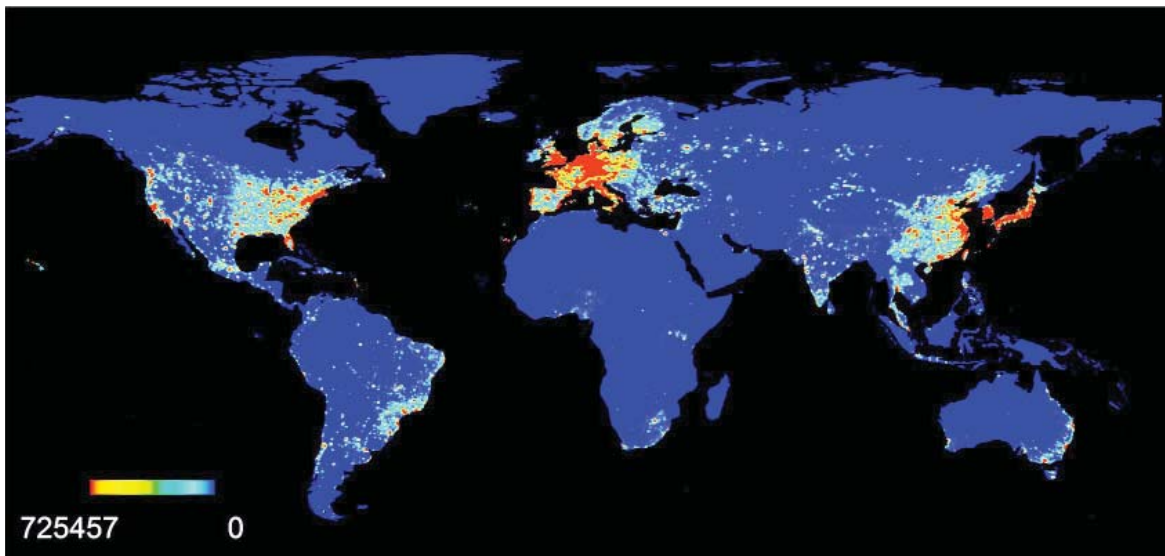


Figure 4. [In color online.] Global level interpolation of indexed geoweb content, 2011.

is overwhelmingly about urban areas and highlights the urban–rural divide in the amount of content layered over places like the US.

This view clearly illustrates the variable density in geoweb augmentations that occurs at multiple scales. While there are large amounts of content layered over urban parts of North America, Europe, and parts of Asia, there is very little content anywhere else and this unevenness is repeated within countries and cities. These findings mirror other work which has shown similar patterns in the distribution of Tweets, Flickr photos, and Wikipedia pages (Graham et al, 2011; Poorthuis, 2010) and highlight the uneven distribution of reference and representation of material places.

The stickiness of information cores and peripheries, even in an age of supposed friction-free communications, is concerning because of Harley’s (1989) observation that spatial configurations of information both have power and reproduce power. Because of its uneven geographies, the power/knowledge nexus is thus inherently inclusionary and empowering for some people and places and inherently exclusionary and disempowering for others. Knowledge clusters that are reinforced by repeated rounds of spatial fixes can thus result in, and reinforce, a landscape of uneven geographic development (Downey, 2008).

Uncovering the linguistic spatiality of the geoweb

Building upon the findings of differentiation in geoweb content in general, this paper now asks: what are the spatial footprints of different languages in the geoweb? This topic is addressed first through an analysis of the relative visibility of languages within the case-study regions, which provides useful insight on the extent to which the digital augmentation of a location reflects locally spoken languages rather than more global languages such as English. While not a perfect proxy for local versus global divides—for example, English may be widely used by local nonnative speakers—this metric nevertheless illustrates the geolinguistic contours of the geoweb. Building upon these findings, the second approach to this analysis explores how content in different languages augments the same places in very diverse ways. This work illustrates how different groups of people (defined linguistically) move through and enact fundamentally different understandings of place within the same location. This analysis was achieved through a close review of five regions (Canada, Spain, Belgium, France,⁽⁴⁾ and Israel and the Palestinian Territories) that have complex linguistic practices.

⁽⁴⁾Unlike the other four examples, France is not characterized by multiple dominant languages. However, the case was selected in order to compare the native language (French) with one of the

Language footprints in hybrid spaces

Eastern Canada has long been defined as comprising French-speaking Quebec and English-speaking Ontario, and it could be assumed that online linguistic contours mirror those offline practices. The online geographies of content (shown in figure 5), however, present a more nuanced picture. The map displays the amount of online content indexed in English versus French, based on the following metric. First, the maximum values for both languages were summed to produce the total level of French and English keywords at any point. Second, the maximum value for English keywords was divided by this summed total, creating a ratio where 1 indicates only hits for English keywords and 0 indicates only hits for French keywords. Points without hits for English or French keywords were excluded from the map. Because the words ‘restaurant’, ‘Internet’, and ‘Christian’ are identical in both languages, these words were excluded from this analysis. For the remaining fifteen search terms in each language the maximum number of hits for that language at each point was identified. The terms that produced the most hits vary from point to point and between languages, but the terms ‘government’, ‘love’, and ‘music’ are the most likely to have the largest number of hits at any point, and one of these three keywords had the maximum number of hits, at 60% of sampled points.

The resulting map shows the difference between English and French use within Ontario and Quebec. The city of Toronto and most of Ontario is heavily patterned by English content. Ottawa is also predominately tagged with English-language content, although Gatineau, Quebec, which borders Ottawa to the north, can be seen to be predominantly tagged with French terms. This trend continues as one moves east into Quebec, with the city of Montreal being a close to even split between English and French tags and surrounded by a hinterland

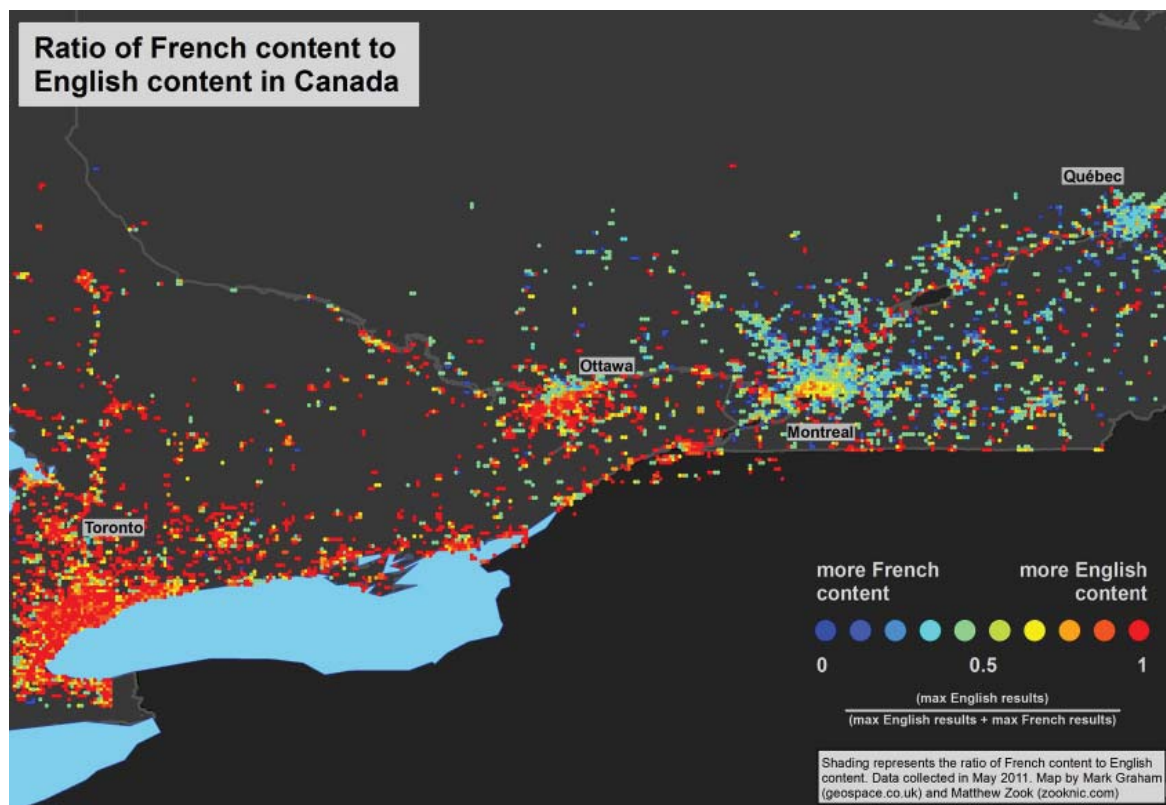


Figure 5. [In color online.] Ratio of French content to English content in Ontario and Quebec, Canada. of overwhelmingly French tags. Moving further to the east, Quebec City has far more French dominant languages on the Internet (English).

content than English. In short, this region of Canada displays a clear, well-demarcated, English-to-French gradient in its geoweb that largely reflects offline linguistic practices and shows that the subnational boundaries observed by Mackay (1958) more than fifty years ago still persist.

A similar mirroring between offline and online geolinguistic contours was observed in Spain when comparing the amount of geoweb content in Catalan and Spanish (Castilian). Using an equivalent metric to that used in the Canadian case—albeit relying on the six keywords which were sufficiently different between Spanish and Catalan—figure 6 also shows a reflection of offline language use in the linguistic patterns of the geoweb in Spain. Throughout much of the Catalonian region in the Northeast coastal areas there is considerably more content in Catalan than in Spanish. Although similar to the previous example, the demarcation is less well defined as a number of locations within Catalonia are associated with considerably more Spanish than Catalan content. While we have only a limited sample of content, this finding points to some of the difficulties of creating even a baseline layer of augmented content in linguistic enclaves that are surrounded by larger languages (that tend to be associated with powerful political, cultural, and economic groups).

Another example of the ties between online and offline geolinguistic practices is evident in the case of Belgium, shown in figure 7. As with the previous two cases, the maximum values for both Flemish and French (limited to twelve terms in order to remove overlap) were summed to produce the total level of French and Flemish keywords at any point. The maximum value for French keywords was divided by this summed total to create a ratio where 1 indicated only hits for French keywords and 0 indicated only hits for Flemish keywords. Points without hits for Flemish or French keywords were excluded from the map. The resulting geovisualization almost perfectly mirrors the divisions between Flemish-speaking Flanders and French-speaking Wallonia, with the capital city of Brussels (located in the center of Belgium) exhibiting a much more even split between the two languages.

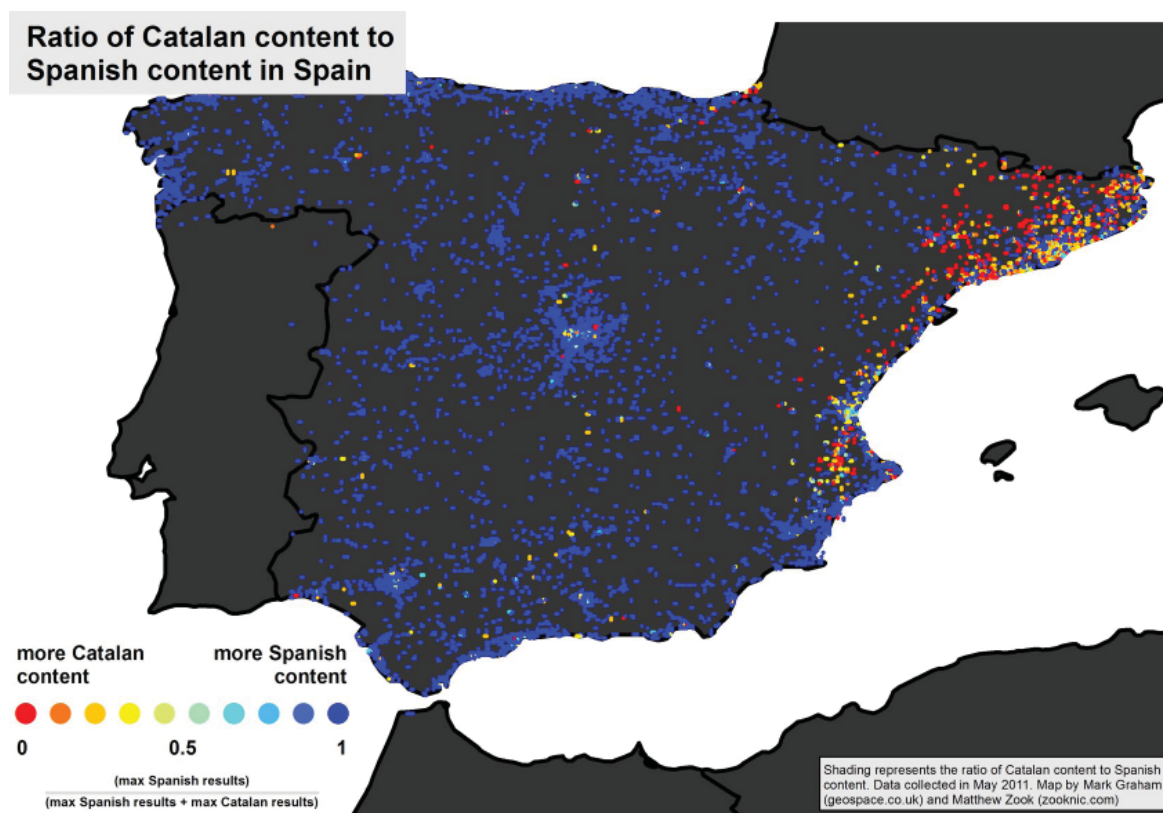


Figure 6. [In color online.] Ratio of Catalan content to Spanish (Castilian) content in Spain.

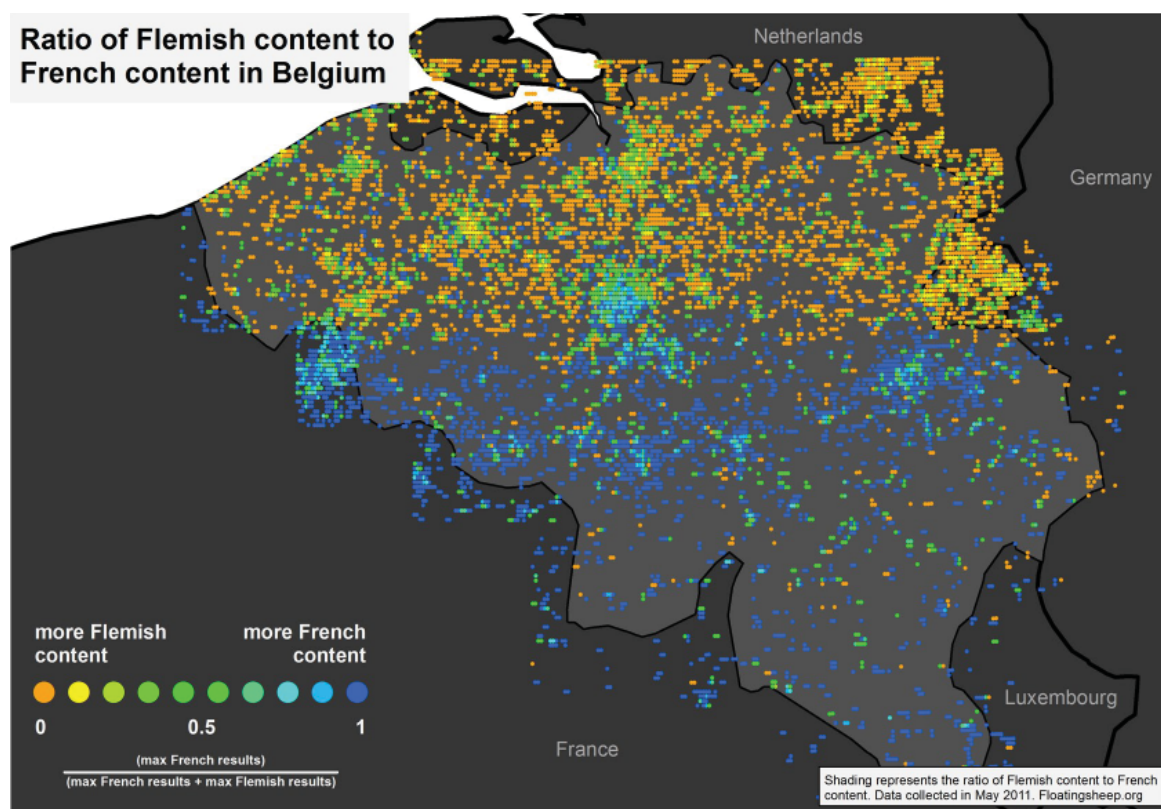


Figure 7. [In color online.] Ratio of Flemish content to French content in Belgium.

None of the previous examples focuses on regions with such significant and unbalanced power dynamics between linguistic groups as those that exist between Arabic and Hebrew in Israel and the Palestinian Territories. Because these two languages use different scripts, all eighteen keywords were included in this analysis; the results are presented in figure 8. As with the previous maps, the maximum values for both Arabic and Hebrew were summed to produce the total level of Arabic and Hebrew keywords at any point. The maximum value for Arabic keywords was divided by this summed total to create a ratio where 1 indicated only hits for Arabic keywords and 0 indicated only hits for Hebrew keywords. Points without hits for Arabic or Hebrew keywords were excluded from the map.

This map illustrates the much less dense nature of the geoweb in this region, as large parts of the territory are not augmented by geoweb content in either language within Google's database. In addition, it shows that in the places with geocoded content there is a much more dense cloud of Hebrew content—even in places that are under the political control of an Arabic-speaking population. For example, searches in Arabic within the Palestinian Territories generally result in only 5% to 15% of the number of hits that the same search term in Hebrew brings. Highlighting even further the relatively limited footprint of geoweb content in Arabic is the fact that searches for the same terms in English result in four to five times as many hits as the Arabic equivalent. In other words, the Arabic representation of places within Israel and the Palestinian Territories is much more limited both in scope and in scale than what is available in more dominant languages of the region and world.

While the aggregations of keywords shown in figures 8 to 11 are relatively blunt tools, they provide an important measure of some of the differences in linguistic footprints on the geoweb. The same presences and absences that have long characterized Internet content continue, (re)making some parts of the world into digital terra incognita. Likewise, the digital footprints of language in the geoweb are readily visualized and in some cases can be particularly sharp—for example, the transition from English to French content in

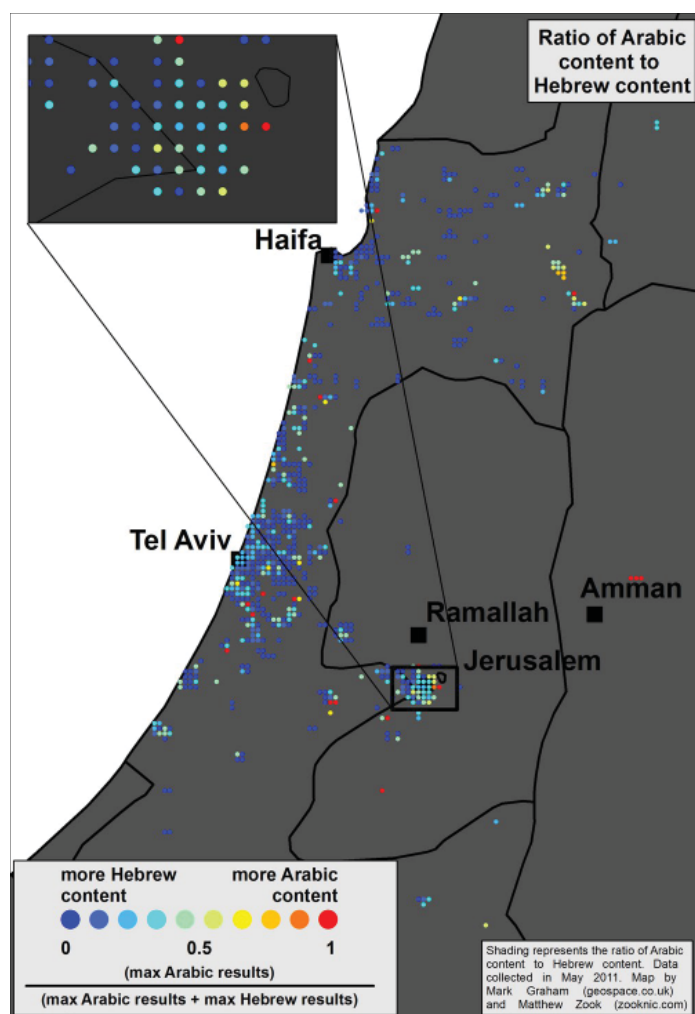


Figure 8. [In color online.] 8. Ratio of Arabic content to Hebrew content in Israel and the Palestinian Territories.

Ontario and Quebec—while other regions, such as Spain and Belgium, display much more irregular patterns with linguistic enclaves and blendings. Finally, and perhaps most importantly, this analysis highlights that the geoweb is not a detached alternate space beyond the power imbalances between populations in the offline world. Instead, we see that it can further empower dominant groups by mediating representations of places that reflect many underlying imbalances and patterns in the availability of content.

Diverse contours of linguistic augmentation

The differences in the relative visibility of languages within a region leads to the second question, concerning how places are augmented in very different ways depending upon the language. What do the variable geographies of content tell us about who these virtual landscapes are designed by, and who created them. Although the sample of words in this analysis is limited, its use highlights a number of intriguing differences in the type of content layered over the material environment. Figure 9 illustrates the relative visibility of words in the sample in English, French, and Flemish in Belgium. The similar level of focus on all of these words in the virtual representations in all three languages suggests that the representation of place within Belgium is broadly parallel. All three languages have a large number of references to ‘music’, and relatively few to ‘democracy’ or ‘flu’ (although figure 7 reminds that the density of each language’s representations vary across space). Moreover, there are a number of suggestive differences in the number of references in each language to certain

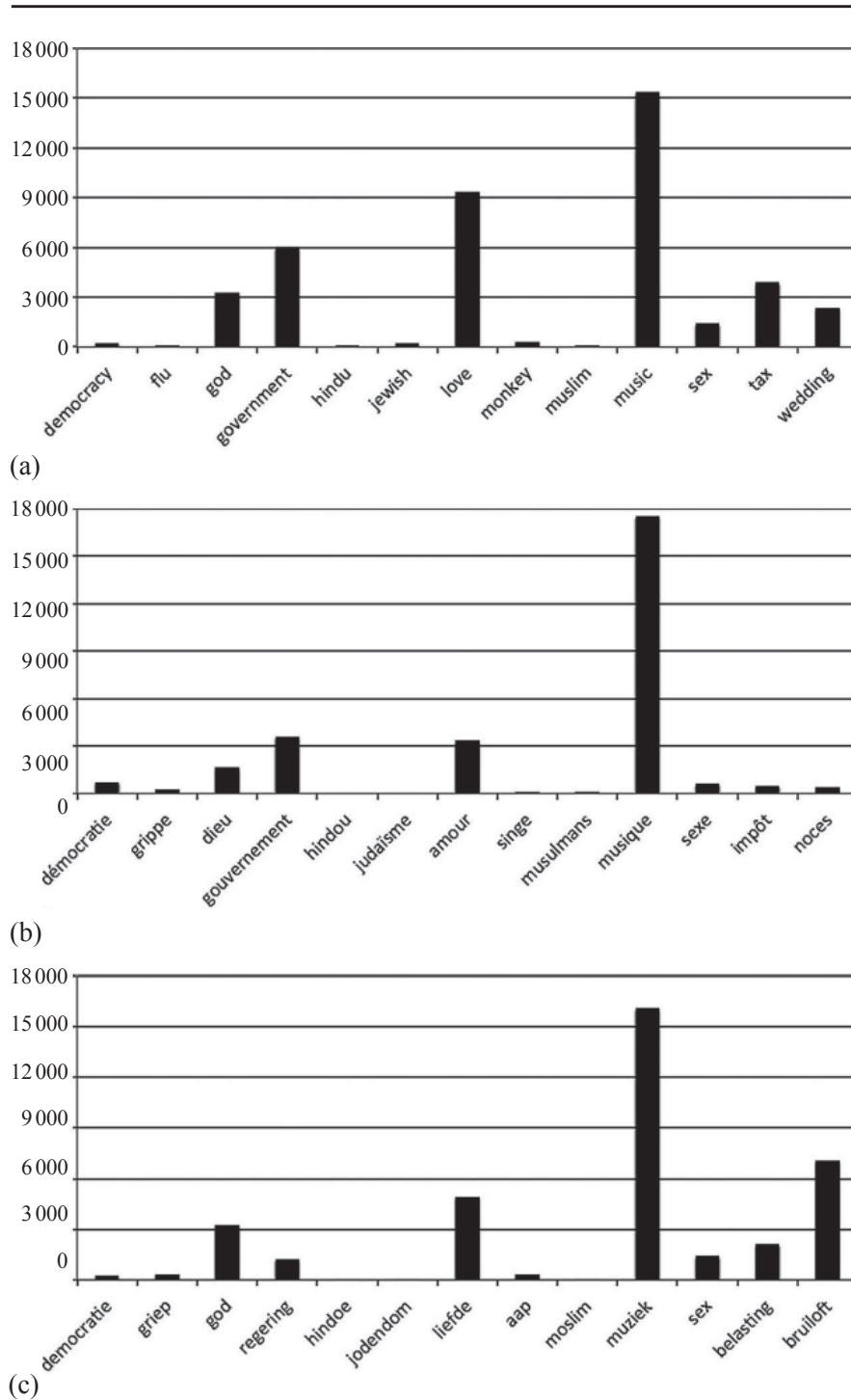


Figure 9. Relative visibility of keywords in (a) English, (b) French, and (c) Flemish in Belgium.

keywords. For example, there are seven times the number of references to ‘government’ as to ‘tax’ in French, whereas Flemish speakers encounter the reverse.

The differences in available content is much starker when comparing the Arabic, English, and Hebrew layers of the geoweb in Israel and Palestine (figure 10). For our sample of words, there is very little content indexed in Arabic—with the exception of the word ‘muslim’. In English, religious words also have a relatively high rate of occurrence, with relatively high number of references to the terms ‘jewish’ and ‘muslim’. In contrast, the number of hits for religious terms is relatively low in Hebrew and, instead, words like ‘tax’, ‘music’, and ‘love’ appear most often. These differences are extremely relevant as they demonstrate that not

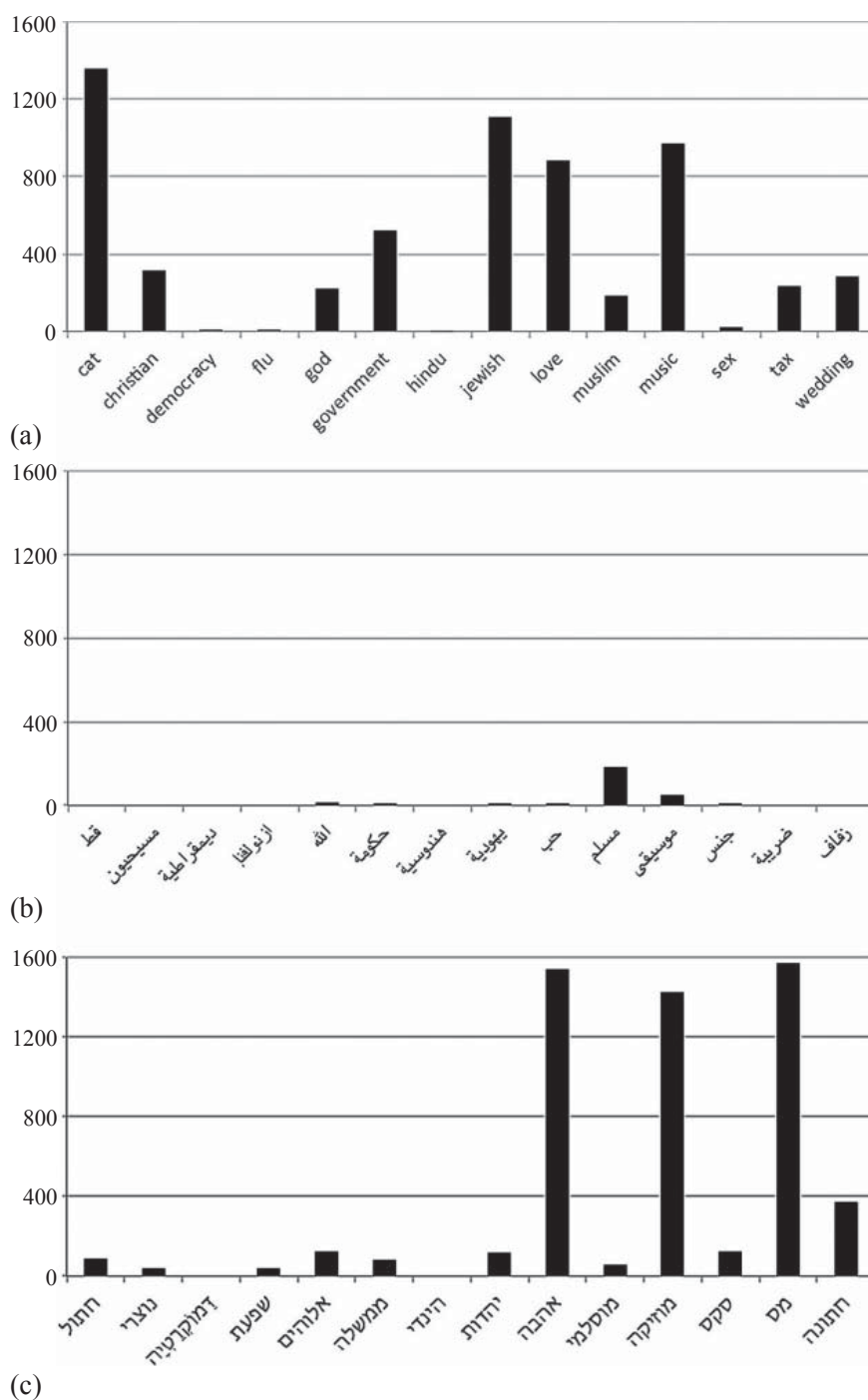


Figure 10. Relative visibility of keywords in (a) English, (b) Arabic, and (c) Hebrew in Israel and the Palestinian Territories.

only does the density of linguistic footprints vary over space, but their potential objects of attention also differ substantially.

This phenomenon is aptly illustrated by a number of the case studies in which the specific geographies of search terms differ across space. For example, in Spain a comparison between relative visibility of the word ‘love’ in Spanish and in English (figure 11) reveals that, while the Spanish term is predominant overall, there are clusters of locations along the Mediterranean coast at which there are more references to the English word. These agglomerations are centered in tourism regions of Costa Brava, Costa Blanca, and the Andalusian coastline, and closer inspection reveals that these concentration of hits are tied primarily to tourism related references to hotels, restaurants, and other activities that are targeted at non-Spanish visitors.

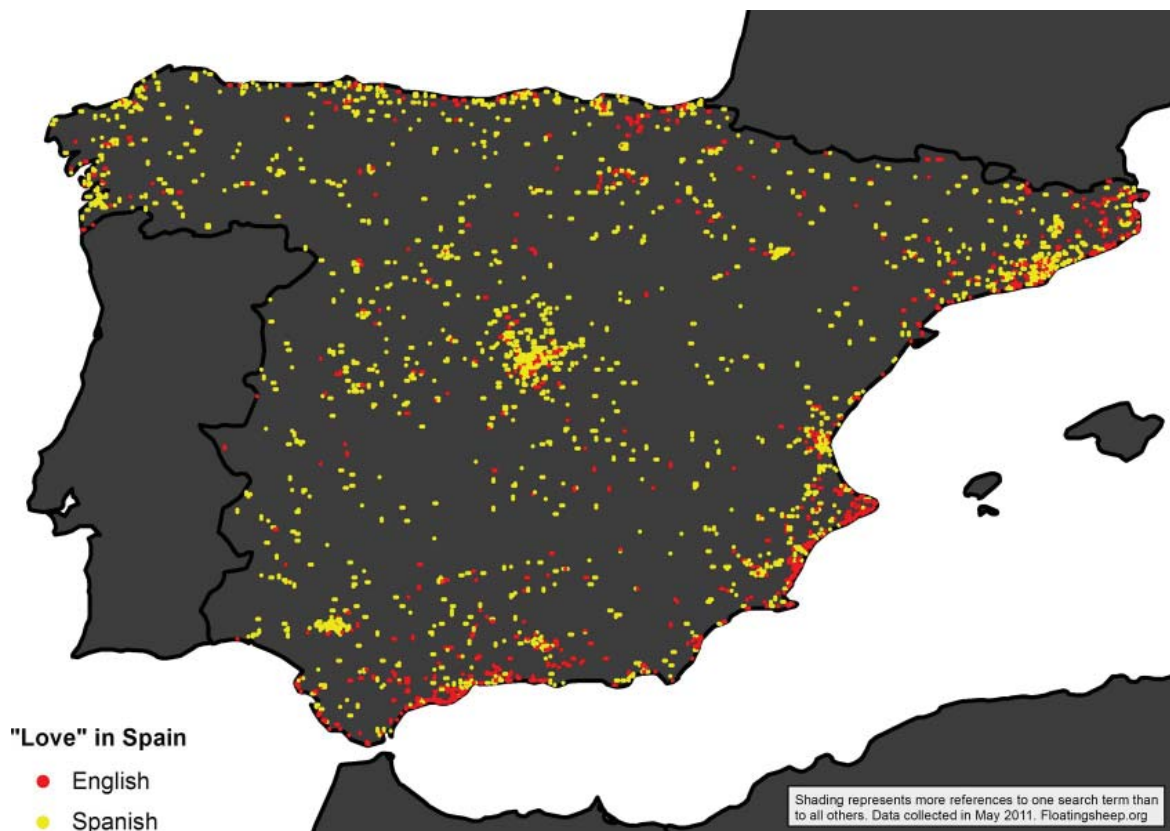
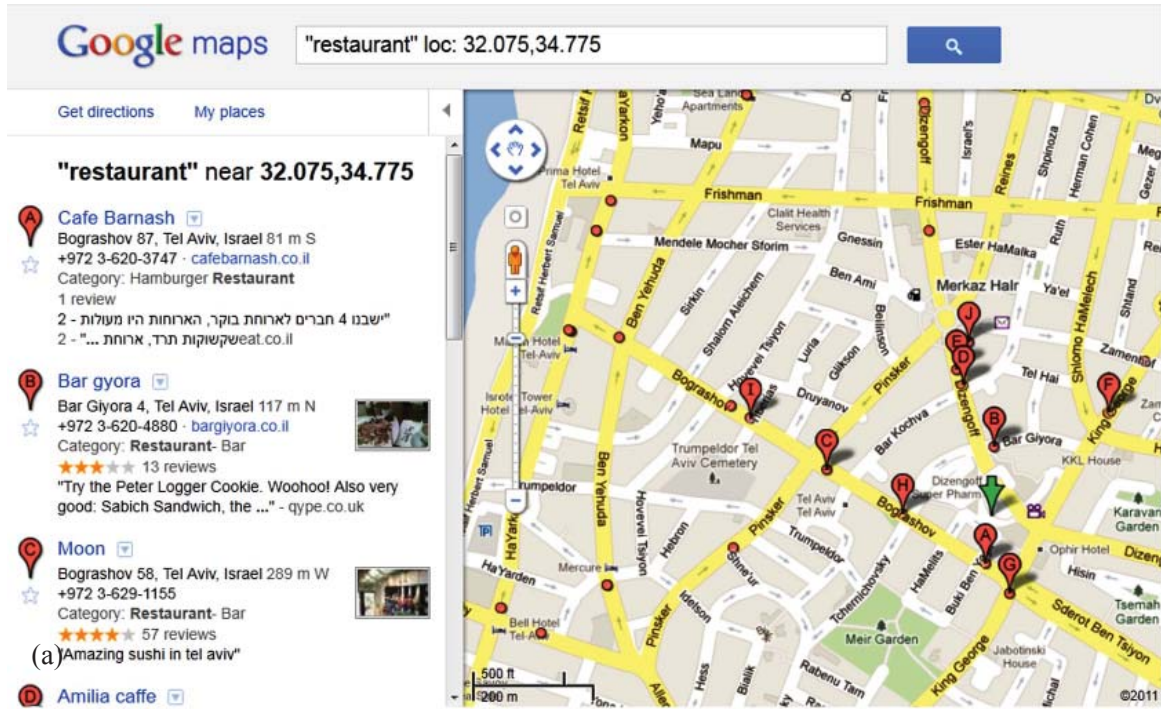


Figure 11. [In color online.] Relative visibility of the keyword ‘love’ in English and Spanish in Spain.

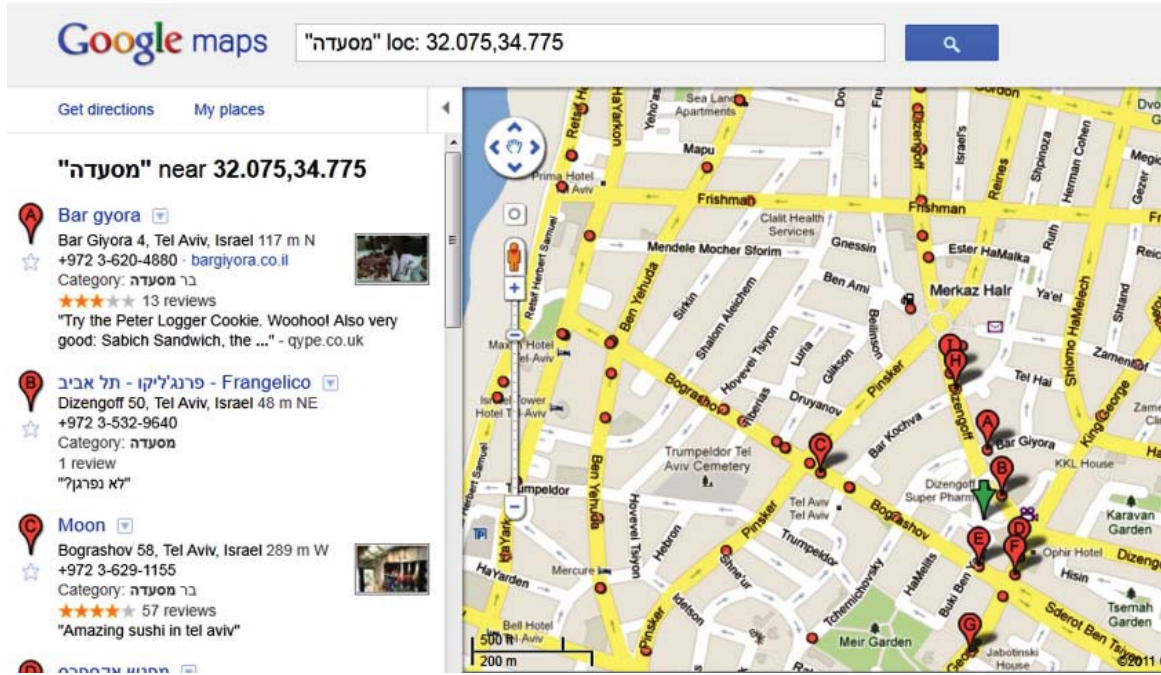
As such, this figure provides an illustration of how the audiencing of augmentations can be alternately directed to a range of groups: ranging from the highly local (eg, interpersonal relationships), to the global (eg, tourist sites).

This linguistic difference within a place is particularly well illustrated by the example shown in figure 12, outlining the variability in representation of the same place. Each of the Google Maps search results show the selection and ranking of places that result from a search conducted at the same location for the word ‘restaurant’ in English, Hebrew, and Arabic. Not only is there a difference in the amount of material available—Hebrew and English both have considerably more hits than Arabic—but the restaurants that are selected and the order in which they are presented is considerably different for each language. The starkest contrast is evident with the results for ‘معمطم’ (‘restaurant’ in Arabic) which present a lunch seeker with an entirely different representation of spatial choices than those offered to English or Hebrew language users.

The examples of Belgium, Spain, and Tel Aviv are replicated in countless ways across the globe as the divergent interests and experiences of various social groups (defined linguistically and otherwise) is reflected in the process of creating websites, reviews, placemarks, and other content that are indexed within the Google Maps and other geoweb interfaces. Such uneven geographies and linguistic spatialities ultimately mean that fundamentally different online geolinguistic spheres and layers are not just being produced and reproduced, but also continuously enacted and reenacted. As such, our ability to create and interact with the representations afforded by the geoweb, understanding the contours, processes, and politics behind the layering of virtual content over the material environment, increasingly matters.

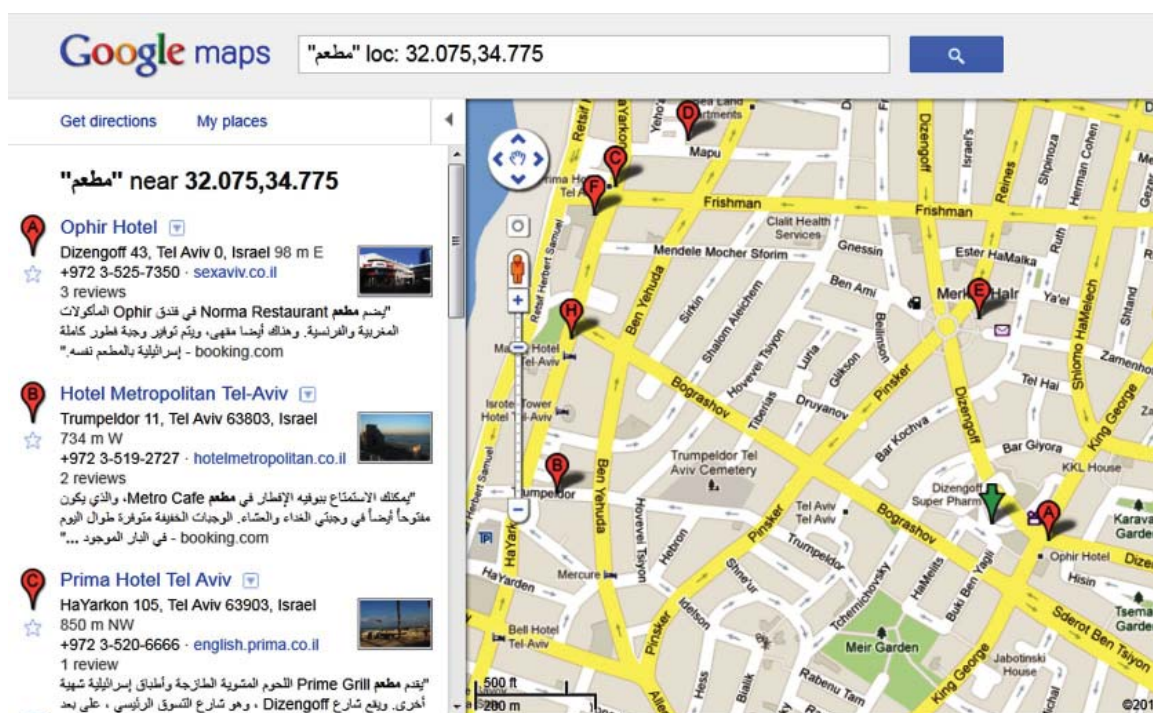


(a)



(b)

Figure 12. [In color online.] Relative visibility of the keyword ‘restaurant’ in Tel Aviv, Israel in (a) English, (b) Hebrew, and (c) Arabic.



(c)

Figure 12 (continued).

Conclusions

This paper highlights the importance of geographic research into more than just the densities of information that cover our material world. While tracking information densities remains crucial for further research, questions about the nature and power relations embedded in this information are increasingly relevant and answerable. In addition to uncovering where, we seek to understand what, why, and who. A key part of these answers are the languages of information layers as they shape both the content that is available and determines who will likely access it. These uneven linguistic geographies, in turn, influence the many ways in which place is enacted and brought into being (Graham and Haarstad, 2011; Graham et al, 2012; Kitchin and Dodge, 2011).

Contributions of spatially relevant information to online platforms can, in many cases, appear trivial, playful, and apolitical, but in all cases those contributions shape the informational ecosystems overlaying material places. Tweets, restaurant reviews, Wikipedia articles, placemarks listing protest sites, and all of the myriad ways in which people are annotating their environments become part of the indeterminate, unstable, context-dependent, and multiple realities that emerge and are brought into being through the subjective coming together in time and space of material and virtual experience.

While this paper is limited to a handful of case studies, the examples presented here provide important insights on the ways in which groups of people can encounter fundamentally different information spaces within the physical places they inhabit. We acknowledge that the number of search terms we have used is limited, and caution against reading too much into any of the specific geographies of the words used. What is more important is the ways in which these mappings provide insight into the geolinguistic contours of a place and its representations in the geoweb (eg, results for ‘love’ in different languages might not tell us anything about love, but are still a rough proxy for underlying patterns of language usage).

With these caveats in mind, the analysis and mappings in this paper lead to three key conclusions. First, some parts of the world are clearly mirrored by denser augmentations

than others. While the urban areas of North America, Europe, and parts of Asia contain a large amount of indexed geoweb content, much of the rest of the globe is largely absent from virtual representations. Moreover, other research (eg, Graham et al, 2011) has shown that this same pattern exists in the distribution of Tweets, Flickr photographs, and Wikipedia pages. While in some ways this reflects earlier patterns of information technology adoption and core–periphery structures, it also demonstrates how global information use has become less linguistically restricted than was the case in the 1990s.

Second, the case-study analysis of the geolinguistic contours of the Web demonstrates that some languages enjoy far greater visibility than others. English-language content, in particular, annotates a broad range of places while most other languages examined are mostly confined to their expected national and linguistic boundaries. At the same time, in places like Israel and the Palestinian Territories, that are home to mother-tongue speakers of multiple languages, language visibility seems closely correlated to socioeconomic status and political power. Content in Hebrew overshadows Arabic throughout the study area, including many locations within the West Bank. A similar effect can also be seen within Quebec, where the central city of Montreal has more English-language content despite being embedded within Francophone Canada. This is potentially problematic because when content is unavailable in a local language, it becomes unlikely that cultural practices and representations conveyed by that language will be made available to its speakers (El Zaim, 2010). Even more worrying is that “given the widespread use of ICTs ... the de facto language imposed on users (be it English, French, Spanish, Arabic, or other) ends up gaining the upper hand and replacing the local language for ICT and other purposes” (El Zaim, in Osborne, 2010, page ix). The geoweb, therefore, not just opens up spaces and possibilities for the creation of locally relevant information, but can also allow for an amplification of the already most visible or powerful voices.

Third, it is clear that the density of content about specific topics varies across languages, with some keywords far more likely to be indexed in some languages than in others. For example, in Israel one is more likely to encounter content referencing religion in English than in Hebrew; but one is also more likely to come across content referencing music or taxes in the same places in Hebrew. Building on our second conclusion, these differential augmentations of place can potentially set up path dependencies of representation within each geolinguistic bubble.

While we are cautious in ascribing too much weight to these initial findings, these results suggest a typology whereby one can differentiate between issues of local concern (taxes) and global concerns (sites sacred to multiple religions). Much of this is contingent on the local conditions and activities within a location: references to the Spanish word for ‘love’ are visible throughout Spain, but within the tourist regions, with large expatriate populations, a shift to references in English is visible, mirroring the more global interest in these specific spots within the region. Moreover, depending upon the context of the case study, a language can be used by both a local and a global population. For example, content in Arabic within the Palestinian Territories can derive either from local Palestinian sources or can be the result of interest from Arabic-speaking populations from other locations. In short, the different contours of geolinguistics illustrated in this paper are evidence of much more than a simple local–global binary.

One of the oldest critiques of the Internet is that it gave rise to dominance; amplified the loudest voices; and brought everyone into the same informational sphere. In this paper we have examined the potentials for digital augmentations to do something different: specifically because augmented content is by its very nature local and presumably localized. Platforms like Google Maps do seem to have provided a metaphorical and virtual space to different

groups of people to create locally relevant information in the same places. We have seen that there are uneven geographies of content, but the fact that different geolinguistic virtual spaces have different objects of attention is not necessarily automatically a cause for concern. More pernicious is the fact that it is difficult to examine how these uneven geographies are taking shape.

In conclusion, it is important to think more carefully through the potentials for uneven path dependencies of information and action. In this analysis we have seen a lot of content about certain objects of attention in some languages because those objects are necessarily of interest to speakers of that language ('Christian' in English in Israel, for example). But does it matter that different augmentations are being created for different groups of people? Users are not just being presented with filter bubbles of information, but are actually being presented with fundamentally different cities and material places. Balkanised bubbles of augmented information could thus help to reinforce real, material, balkanized spaces in a very real way.

Carrying out geolinguistic analysis is undoubtedly important to other researchers and to policy makers (Cartwright, 2006). But to move this debate forwards, we need both to engage in more detailed empirical studies, and to more carefully theorize how filter bubbles of augmented content affect our understandings of and interactions with the world and might reinforce balkanized hermetically sealed imagined spaces. Ultimately, we hope that these initial mappings of the linguistic contours of the geoweb will help us to push forward a broader debate about how augmented inclusions and exclusions, visibilities and invisibilities, will shape the way in which places become defined, imagined, and experienced.

Acknowledgements. The authors wish to acknowledge Matt Wilson and the three anonymous reviewers for their helpful comments. We also would like to acknowledge the organizers of the Oxford Internet Institute's "A Decade in Internet Time" for providing the encouragement and opportunity that resulted in this paper.

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