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**The Algorithm and the Crowd:
Considering the Materiality of Service Innovation**

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Abstract

This special issue acknowledges important innovations in the world of service and within this domain we are particularly interested in exploring the rise and influence of web-based crowd-sourcing and algorithmic rating and ranking mechanisms. We suggest that a useful way to make sense of these digital service innovations and their novel implications is to recognize that they are materialized in practice. We thus need effective conceptual and analytical tools that allow us to take materiality seriously in our studies of service innovation. To this end, we propose some theoretical ideas relating to a sociomaterial perspective, and then highlight empirically how this perspective helps us analyze the specific service materializations enacted through the algorithmic configuring of crowd-sourced data, and how these make a difference in practice to the outcomes produced.

Introduction

The concepts of service and service innovation have attracted considerable recent attention in the fields of marketing and operations (Gustafsson and Johnson 2003; Vargo and Lusch 2004, 2008; Rust and Chung 2006; Spohrer and Riecken 2006). While manufacturing remains an important arena of economic activity, services have emerged as the main source of job creation in OECD countries (Bardhan et al., 2010; Sheenan 2006), accounting for approximately 80% of economic activity (NAE 2003). There is increasing talk of a service-based economy, with the services sector providing core infrastructures through which businesses compete and expand, domestically and globally. It is estimated that services account for 20% of international trade, challenging businesses to work across temporal, geographic and cultural boundaries. Working across such boundaries — in effect, engaging with different “service worlds” (Bryson et al. 2004; Barrett and Davidson 2008) — has heightened awareness that the ways in which service interactions, relationships, and encounters are structured matters (Guttek et al. 2000). As information systems become more central to the structuring of services, there is growing recognition that technology not only increases their scale, scope, and reach, but also shapes their design, delivery, and influence (Ramiller and Chiasson 2008).

Rouse and Baba (2006, p. 69) note that accounts of work may be constructed from many different perspectives, each of which holds its own distinct value and each of which cuts the world in its own way:

Engineering tends to see work in terms of the flow of physical items that are machines, assembled, and so on. Computing sees work as the flow of information to support the activities associated with work. Architecture views work in terms of the flow of people through built environments.

They suggest that the field of information systems has a long tradition of systems thinking and socio-technical approaches that recognize the social/cultural aspects of work in addition to the technological ones, emphasizing that (2006, p. 70):

... work organizations are not solely technical or rational systems designed to accomplish managerial goals, but they also embed natural or social systems whose characteristics extend beyond the rational and thus connect them with all other human social groups.

Historically, socio-technical systems were associated with the trade union movement and a theme of worker empowerment tempered the overall goal of joint optimization. Re-engineering largely pushed ethical concerns and emancipatory politics to the background as the terms of information systems shifted from job enhancement to rationalization. Identifying discrete technical and social elements in order to optimize them — as epitomized by the original socio-technical systems approach — thus shifted from improving performance through work-life enrichment to a drive for systems efficiency. Today, it is generally accepted that if service innovation is to be effective, we need to understand not only local work systems but also broader enterprise relationships and how to support them. Indeed, within information systems, some have proposed adopting a “services rather than traditional systems perspective” to understand contemporary technological practice (Mathiassen and Sorensen 2008, p. 313).

Much debate surrounds the question of how to effectively conceptualize and theorize service (Barrett and Davidson 2008). The service innovation literature has highlighted how boundaries between the categories of products and services have been blurred, emphasizing the importance of relationships and performances, and generating discussion about what should be labeled as “service” (Lovelock and Gummesson 2004; Rust and Chung 2006; Vargo and Lusch 2004, 2008). Motivating these discussions is a sense that: “The dominant, goods-centered view of marketing not only may hinder a full appreciation for the role of services but also may partially block a complete understanding of marketing in general” (Vargo and Lusch 2004). We would argue that this applies equally to the study of service-centered information systems.

The existing literature on services and service innovation has generated important insights into the dynamic and continuous interactions that shape the development and delivery of services. Our interest here is to extend these insights by arguing for the importance of materiality in service dynamics, and in particular, to draw attention to contemporary technological developments involving algorithmic transformations of crowd-sourced data. In the following sections we articulate the value of considering the materiality of services and consider potential conceptual insights that may be generated from a sociomaterial perspective. We then discuss

some empirical cases in social media to explore how services are materialized in specific boundary-making and performative practices. We end with some considerations of possible future research directions.

Calling out the Materiality of Services

A key theme guiding the current discussions in this area is the notion that the conventional dominance of goods over services is no longer appropriate or useful (Vargo and Lusch 2004), prompting a move to reconceptualize products in terms of services (Gustafsson and Johnson 2002). Iconic examples highlight corporations, such as GE, IBM, Xerox, and Interface, undergoing a process of “servitization” in which they re-categorize themselves from product companies to services groups. As Rust (1998, 107) writes: “[M]ost goods businesses now view themselves primarily as services, with the offered good being an important part of the service (rather than the service being an augmentation of the physical good).” A foray into the back-office realm of legal and regulatory contracts reveals that the move to “servitize” is reconfiguring not only design and logistics, but also infrastructures, boundaries and power relations. These are evident, for example, in the shifts to outsourcing contracts that are transforming internal functions into inter-organizational service relationships and in the rise of performance-related job contracts that are establishing internal markets premised on service relationships (Spohrer et al. 2007). In the field of Information Systems, important contemporary developments — such as cloud, grid, and web services as well as smart, wearable, and mobile technologies — are involved in such transformations as contractually-bound business grids, digital ecosystems, and on-demand and availability-based service level agreements. These service developments build upon and extend established core infrastructures and progressive institutionalization of standards (Bardhan et al., 2010; Chesbrough and Spohrer 2006; Tilson et al., 2010).

Most scholarship has recognized that for service to be effective, it must have meaning that comes from its embeddedness, and so our efforts focus on how to produce analyses that engage with the complexities of context. Chandler and Vargo (2011) emphasize the influence of context on

value co-creation in services, while Ramiller and Chiasson (2008) suggest moving from discrete models of service to the notion of an “organizing vision” encompassing multiple contextually relevant discourses — regulatory, governmental, ethical as well as commercial, technological and entrepreneurial. They suggest that understanding broader organizing visions (2008, p. 15):

... helps define how people and their organizations think substantively about the possibilities while also lending normative force to the service innovation. In this way, public discourse can have an institutionalizing effect that helps to move the innovation toward a taken for granted status, even as it serves as a resource in an organization’s local sensemaking.

We argue that what enacts this organizing vision, drawing the topology of concerns together, is practice. Practice perspectives focus on people’s everyday doings, and examine the structural and interpersonal elements that produce and are produced in those doings (Feldman and Orlikowski 2011). Practices are understood to be constitutive, and as such both dynamic and ongoing. Practices are engaged in by people as part of the structuring processes through which institutions and organizations are produced, reinforced, and transformed over time (Giddens, 1984). Adopting a practice perspective thus requires neither a choice between a macro or a micro level of analysis, nor a conflation of the two. Instead, it directs attention to how institutional phenomena are constituted in everyday activities, and how those everyday activities, in turn, are shaped by institutional influences and entailments.

As a focus of analysis, studying practice requires attending to recurrent, situated activities informed by shared meanings (Schatzki, Knorr Cetina and von Savigny, 2001). On these grounds, we argue that a practice-based approach to studying service and service innovation would thus be particularly useful. Practices offer a valuable lens through which to analyze shifts in service because they enable us to engage deeply with everyday activities and produce insights into value generation across multiple interests implicated in reconfiguring resources and restructuring relationships (Barrett and Davidson 2008; Chesbrough and Spohrer 2006; Vargo and Lusch 2004).

Many of the case studies from sectors such as entertainment, hospitality, software and logistics emphasize the reconceptualization of tangible products as intangible services, and place

considerable importance on the reorganization of non-physical assets and resources that accompany the shift to “servitization.” As Vargo and Lusch (2004, p. 15) argue: “The focus is shifting away from tangibles and towards intangibles, such as skills, information, and knowledge, and toward interactivity and connectivity and ongoing relationships.” We offer three extensions that build upon the current framing, foregrounding aspects that have been present but in the background to date. In particular, we want to focus on: the constitutive role of practices in services, the materiality of services, and the performative consequences of services materialization.

First, *services (and goods) are constituted in practice*. While much of the early work in economics and marketing privileged a goods-orientation that tended to treat services as residual, this has now been replaced with a service-centered view that highlights exchange processes, the co-creation of value, and core competences. This is a valuable move, particularly given the shift to a service economy. However, it has tended to replace one dominant logic (that of goods and tangible resources) with another one (that of service and intangible resources). As Vargo and Lusch (2008, p. 256) further note:

In S-D [service-dominant] logic, ... it is the knowledge and skills (competences) of the providers that represent the essential source of value creation, not the goods, which are only sometimes used to convey them. Thus, in S-D logic, goods are still important; however, service is superordinate.

Both the goods and service-dominant logics overlook the ways in which producing and consuming outputs — at the level of practices — are relative similar, in the sense that they entail a range of activities, bodies, and artifacts. For example, the manufacture of a refrigerator and the writing of accounting software both involve human bodies engaged in an array of recurrent activities (designing, prototyping, building, marketing, etc.) involving multiple artifacts (workplaces, tools, machines, forms, etc.). In the same way, the experience of using a refrigerator or running a piece of software involves human bodies engaged in an array of recurrent activities (shopping, loading, retrieving, balancing, etc.) involving multiple artifacts (kitchens, offices, groceries, receipts, bank statements, checks, etc.). From a practice perspective, thus, goods and services both require the coordination of activities, bodies, and artifacts to be produced and

consumed. Rather than seeing these as orthogonal, we believe there is analytical value in seeing both as constituted in practice.

Second, *services (and goods) are material*. As evident in the quotes above, the prior dominant goods-oriented logic was focused on tangible goods and resources, with the new service-dominant logic oriented around intangible resources emphasizing skills and knowledge (Vargo and Lusch, 2008). However, the presumption of intangibility in the case of service exchange relative to that of goods obscures the way in which both are material. Importantly, materiality is not the same as tangibility, a distinction not always recognized in the literature. For example, Lovelock and Gummesson (2004) equate intangibility and immateriality (p. 24), and distinguish between “material goods and immaterial services” (p. 25). But that we cannot touch or grasp something (intangibility) does not make it immaterial. Consider, for instance, the entertainment service of viewing a movie in a theater (Barrett and Davidson 2008). This is produced, in practice, by embodied consumers located in a certain physical place and time and through a particular projection method. The service of providing and viewing movies cannot exist without some specific material instantiation. Even though projected images may appear to be intangible, this makes them no less material for they only exist in relation to practices that entangle them with phenomena such as theaters, screens, projectors, as well as time and place. Using this same logic, we would make a similar case of software-based services. While software may appear intangible, it only exists in relation to the particular computers, networks, bodies, and workplaces through which it is produced and used. For software to exist, it has to be enacted in some form — minds, computers, code, specifications, etc. As Introna (2011, p. 116) notes, to act in the world requires “material enactment.” Thus, to be real, both goods and services have to be materialized in practice.

Third, *the materialization of services (and goods) is performative*. The specific activities, bodies, and artifacts that are engaged in producing and consuming services are not passive mediators or neutral channels for developing and delivering the intangible essence of the service. On the contrary, what the service is, at any given time and place, reflects the materiality involved

in its constitution in practice (e.g., equipment, media, channels, bodies, buildings, spaces, etc.). For instance, returning to our movie example, the kind of camera used to shoot the movie (one for professional film making or one to record home movies) makes a difference to the movie viewing experience, as do the specificities of how the movie is being projected (in a theater or streamed through the Internet to a mobile device). Indeed, even a cursory review of the history of film production, reveals how significant the material capabilities of film, cameras, studios, directors, scripts, actors, projectors, theaters, VCRs, DVDs, video streaming, etc., have been to both the production and consumption of movie entertainment. Remove the film, cameras, studios, directors, scripts, actors, projectors, theaters, VCRs, DVDs, or video streaming from the practice, and you no longer have a service that is recognizable as movie entertainment. Similarly, the quality and operation of software depend critically on the material capabilities of the activities, bodies, and artifacts involved in its production and use. The specific materialization thus matters to the service that is developed and delivered; it is performative. While the notion of “performance” refers to the doing of an activity (e.g., the playing of the piano), the notion of “performativity” refers to the outcomes produced by the doing (e.g., uttering the statement “You’re fired” in certain circumstances generates a termination of employment) (Austin, 1962; Barad 2003). Uttering the statement “You’re fired” is a specific material enactment because to have effect it requires utterance by an actualized authority capable of its realization. That is, not anybody uttering this statement will produce the reality of terminated employment. Only someone (e.g., a manager) with hierarchical authority within the institution will have that capacity. In the same way, the specific material enactments of services (and goods) are consequential for the outcomes that are produced; they are performative.

Seeing services as materially enacted in practice requires recognizing materiality as inseparable from the constitution of everyday life. A number of scholars have been advocating the importance of artifacts and technology in producing services for some time. For example, studying the processes of ship navigation, Hutchins (1996) has argued that artifacts are an integral part of an extended cognitive system that is embedded in action and memory and which

is (re)configured in response to situated action. Studying financial services, Knorr Cetina and Bruegger (2002) have highlighted the materiality of the screen world that financial traders engage with to perform market deals through electronic communication. Thrift (2004) has proposed the notion of a ‘technological unconscious’ to draw attention to the way that life is (and has been) influenced by a technological milieu as far back as the domestication of fire (see also Hayles 2006; Mackenzie 2006). Drawing on Haraway’s (1997, p. 11) notion of “materialized figuration,” Suchman (2007, p. 227) has advocated “interventions into current practices of technology development” with a view to “critical consideration of how humans and machines are currently figured in those practices and how they might be figured — and *configured* — differently.” Re-conceptualizing service as materialized in practice thus affords valuable analytic purchase on how we understand the production and influence of services in practice.

We propose a relational and practice-based approach on the grounds that such a move re-frames questions in a way that threads through the multiplicity and performativity of activities, bodies, and artifacts involved in generating and experiencing service. Indeed, we argue that by focusing our attention on practice, we are able to see how services are deeply and inescapably configured by their specific materializations in particular times and places. This approach would appear to be particularly important given the increasing digitization of services and the growing dependence on technologies, data, and infrastructures that this entails (Tilson et al. 2010). Effective understanding of digital services and their consequences will require conceptual tools that take materiality seriously in studies of service innovation. We believe that the recently emerging sociomaterial perspective in studies of organizations and information systems may offer a promising approach for doing so.

Exploring Sociomateriality

There are many different theoretical hues within the broad category of approaches that adopt a relational approach to the question of technology. Actor-network theory (Callon 1986; Latour 1992, 2005) is the most well-known of these, and a substantial body of work has been

generated within this area. Other approaches include Pickering's (1995) mangle of practice, Knorr Cetina's (1997) object-centered sociality, and Latham and Sassen's digital formation (2005). Sociomateriality is a more recent approach (Mol 2002; Suchman 2002, 2007) with interest growing in its application to information systems. To date, there have been only a limited number of papers published that explicitly engage with this lens (see Introna and Hayes 2011; Leonardi and Barley 2010; Orlikowski and Scott 2008; Nyberg 2009; Styhre 2010; Yoo 2010). In working within this approach, we draw specifically on insights from the field of techno-science and the contributions of Karen Barad (1998, 2003), which are most fully developed in *Meeting the Universe Halfway* (2007). After a necessarily *précised* account of a few of Barad's complex ideas, we will engage them in the task of unpacking two key aspects of online digital service innovations that are currently gaining considerable prominence: the algorithm and the crowd.

Barad (2007) proposes "agential realism" as her conception of world making, in which the basic unit of reality is the phenomenon, consisting of *intra*-acting — rather than the more typical, *interacting* — agencies. As Schrader (2010, p. 283) observes:

In contrast to interactions that suggest connections between independent entities, intra-actions draw attention to the inseparability of individual (human or nonhuman) agencies, conventionally called 'subjects' and 'objects', 'bodies' and 'environment' *prior* to experimental enactments. Independent of specific material meaning-making apparatuses, [phenomena] remain indeterminate.

Thus, agents, things, or concepts cannot be understood as having determinate boundaries, properties, or meanings prior to their encounters. Rather, they remain ontologically indeterminate and are only constituted through particular entanglements. These entanglements consist of ongoing *intra*-acting agencies (causal relations), which do not exist *a priori* as ontological units but emerge relationally, resulting in "marks on bodies," that is, outcomes that make a difference. Barad regards observable differences — or as Rouse (2004, p. 12) describes them "material indications of phenomena" — as effects of a particular set of practical performances.

For Barad, practices always entail both meanings and materialities, and she signals this with the term *material-discursive*. Importantly, she is using the term discourse in a distinctive way: "Discourse does not refer to linguistic or signifying systems, grammars, speech acts or

conversations... it is that which constrains and enables what can be said” (2007, p. 146). The notion of material-discursive shifts the traditional focus on language and representation towards recognizing that discourse necessarily entails materialization in some form. Discourse and materiality are mutually constitutive. Applied to services, the sociomaterial perspective focuses our attention on the material-discursive practices that produce the service. From this perspective, services and service innovations are contextually situated and performative. This encourages us to examine how services are materialized in particular times and places through particular practices, and how this ongoing enactment configures specific boundaries, properties, meanings, and differences, and with what implications.

Explicating the Materialization of Service in the Hospitality Sector

One particular service arena that has experienced considerable innovation in service design and delivery is that of hospitality. Phenomena within hospitality epitomize many of the key characteristics of service as they are particularly tied to relational dynamics and situated performances. A service within the hospitality sector, such as an overnight hotel stay or dining in a restaurant, necessarily involves the producer and consumer in a detailed engagement during the service experience. Indeed, as Chesbrough and Spohrer (2006, p. 37) note about services:

The services transaction is different. The exchange is co-generated by both parties, and the process of adoption or consumption is an integral part of the transaction. So often the adopter is co-producer, intimately involved in defining, shaping, and integrating the service.

Sociomateriality offers a particularly evocative way of thinking about hospitality services because it fundamentally re-positions service from an *interaction* between two entities, known in advance, that come together to engage in some kind of exchange to a relational *intra-action* through which subjects and objects (thus further relationships and dependencies) emerge through their encounters with one another. For example, consider the service experience of restaurant dining. Far from being a simple transaction involving the interaction of a provider and consumer, it entails a set of complicated and dynamic power relations that differentially configure us as respected guests, paying customers, discerning palates, demanding consumers, victims of the

maître d's dictates, and stakeholders in the local economy. The enactment of such processes is always threaded through a time and place involving seasons, cuisine, views, and settings.

If we make a cut through the entanglement of contemporary hospitality we find that it has recently been transformed by a particular set of sociomaterial practices that have come to characterize travel routines involving the Internet — from search engines, web portals, intermediaries, and aggregators to online reviewing and ranking schemes that rely on user-generated content. The digital provision of travel information is a fast-growing and increasingly significant arena within the hospitality sector. We have been examining the nature and influence of online user-generated content within this sector, and focusing in particular on the role and implications of the TripAdvisor website (Scott and Orlikowski 2012a, 2012b).

TripAdvisor is the largest travel website in the world, hosting over 100 million user-generated reviews and opinions on over 2.5 million businesses (including hotels, restaurants, and venues) in more than 116,000 destinations worldwide.¹ The reviews and rankings provided by TripAdvisor members are used by travelers to “plan the perfect trip.” These also serve as “infotainment” enhancing and extending the practice of travel. Casual browsers of the TripAdvisor website are shocked and pleased to learn about the experience of others guests, picking up tips that help them to book the best rooms as well as learn about points of local and/or special interest that inform preparations for their trip. Purposeful users draw on the multiple reviews, ratings, and rankings provided on TripAdvisor and include them as part of a plurality of sources that they refer to before booking their travel. Indeed, research has found that user-generated reviews can and do influence travelers’ purchasing decisions (Starkov and Price 2007; Vermeulen and Seegers 2009). As members of TripAdvisor, users may post their own reviews online, providing accounts of their personal guest experiences in specific terms and details.

TripAdvisor is an instantiation of “service logic” through which “customers use resources made available to them in usage processes, where the use of these resources renders value for

¹ http://www.tripadvisor.com/PressCenter-e4-Fact_Sheet.html (retrieved July 5, 2013)

them” (Gronroos 2011, p. 240). In turn, the practice of posting online reviews provides the flow of input that enlivens TripAdvisor services by generating data for the databases, ranking algorithms, member preferences, and reputational mechanisms through which contributions are graded, sorted, manipulated and rendered visible on the website.

To explore the specific materializations of the TripAdvisor service in practice, consider the following vignette, compiled from our research field notes to ensure anonymity of our sources:

Molly is seeking a place to stay in Boston for an upcoming trip. A web search activates the Google algorithmic search engine to sift through billions of entries in its indices, producing page after page of websites that review and rank hotels. Hotels that have paid for a sponsored link come first, then those that have the most cross-referenced links, the most frequently visited. If a hotel has a website it appears as a whole entry on the Google page, but if it doesn't, then its name only appears in bold within other listings (including references to TripAdvisor reviews). Molly clicks on the first ten links, disregarding hotels without a webpage. She pulls up four home pages, cross-checks the prices that they have posted with two travel intermediary websites, then clicks through to the TripAdvisor website. In the “town/city” box, under the banner “Find Hotels Travelers Trust” she types “Boston.” TripAdvisor’s Popularity Index produces a ranked list of hotels in the Boston area. Molly reads through the reviews, clicking the “helpful” button if the review is informative, disregarding those that are badly written, plain rude, or posted by people to whom she doesn't relate: “They obviously don't travel much nor do I care as much about the art on the wall” she thinks to herself. Having spent longer than intended on the reviews — entertained by the posting in which a member complains about housekeeping for walking in at an awkward moment, annoyed by another in which a tirade is prompted solely by a waiter dropping a fork at dinner — Molly notes how highly the hotel that appeals to her is ranked and browses through photos of the hotel posted by members. The reviews for this hotel, *The Somerton*, speak to her concerns and are backed up with photos, links and helpful hints. It sounds like her “thing” — close to the places she wants to visit, small/boutique, and trendy but with some facilities for kids. This hotel (and the few others she read about) will appear in the “Recently viewed” box that appears when she returns to the website. Molly needs to book by the weekend but, if she has time, she will ask her East Coast friends if they know the *Somerton Hotel* or know someone who does. If they can come up with local knowledge that trumps that on TripAdvisor she'll reconsider, otherwise the reviews and high ranking on TripAdvisor have persuaded her.

The next day at work Molly's email pings, she glances up and sees a message from TripAdvisor (see Figure 1): “Someone's been reading your reviews.” The message continues “Hi travel_gem! When you reviewed the *Oldebourne House Hotel* last month, you probably wondered if anyone would read what you wrote. Well, more than 1,000 travelers have viewed it so far. You've definitely made a difference. Thank you. Would you like to review another place you've been? Your audience is waiting...” Molly smiles, and raises an eyebrow at the thought of her reviews influencing other travelers. She decides that if the kids get to sleep on time this evening maybe — since her “audience is waiting” — she'll write up an overdue review of the *Blu Hotel*, the most recent hotel where she stayed. If she were to stay there again, she would ask for a room overlooking the square rather than the garage. Other travelers should also know that the hotel is on a flight path: “*That* wasn't on the hotel homepage, now was it?”

At the *Somerton Hotel* in Boston, the manager, Carl, is holding his weekly staff meeting. After working through a number of items on his agenda, Carl pulls up the hotel's TripAdvisor listing on

his laptop for everyone to see. He congratulates housekeeping — Monisha and Stella — for the positive comments received. There is an awkward pause. The receptionist, Mandy, says she would like to talk through the negative comments posted about her online: ‘Hotel was beautiful but the disheveled receptionist couldn't print our bill. She seemed more concerned about her chipped nail than helping us to check out so that we could get to the airport on time and was really rude.’ Mandy says in an embarrassed tone, “I was having a bad day. I hurt my hand pulling the printer out from under the desk to see if I could fix it. I wasn't trying to be rude but nothing was working. It wasn't about my nail varnish being chipped!” Back in his office, Carl puts a call in to the technical team to fix the reception printer, and adds bonuses to the payroll for Monisha and Stella to reward them for their positive mentions. Mandy had gone back to reception reassured that the comments about her were put in context, but Carl could tell it was still weighing on her mind and he worried that this would further distract her. Hotel employees have become terrified of getting a bad review. ... Before leaving for the day — and even though he tries not to look more than once a week — Carl can't resist checking the *Somerton's* ranking on TripAdvisor once again.

After returning from her trip to Boston, Molly is finishing up some work on her home computer, when she receives a member update email from TripAdvisor (see Figure 2). She notices a badge next to her pseudonym “travel_gem” — that indicates she has been promoted from a white to a green star. The text next to it says: “Your Contributor badge tells the TripAdvisor community you're a regular reviewer. Plus, you've received 5 helpful votes from the community. Got more to say? We'd love to hear it!” Molly leans back in her chair: “Ha! Well here is another one for you” she smiles and uploads her review of the *Somerton Hotel*. Having met the criteria of the content management algorithm, it becomes data for displaying on the website and inputting to the Popularity Index. When the database in Newton, US (the headquarters of TripAdvisor), refreshes its computation, the *Somerton Hotel's* position in the ranking of Boston hotels is poised to change.

In this vignette, we see how the services of hospitality — both that of travelers reviewing and ranking hotels, and that of hoteliers servicing their guests — are realized through material-discursive practices. Among these are the sifting of the algorithmic search engine, the specific guest experience conveyed by traveller photos, the order in which the automatically cross-referenced weblinks are used, the practice of opening several websites simultaneously, the TripAdvisor ranking mechanism that displays the most popular hotels in a given region, the user priorities that are created during the search process, as well as working through the broken printer during check-out. The reconfigurations enacted in the process revise boundaries, change meanings, and alter properties, conditioning the performance of all those involved.

While the vignette about Molly's experiences and the examples in Figures 1–3 are discursive — they could be read primarily as language-based narratives — we argue that conceptualizing them as part of a sociomaterial entanglement that is constitutive in practice produces different insights. Molly's engagement with TripAdvisor is configured by her pseudonymous travel_gem identity on the system and the way the system displays certain things

in certain ways on her screen depending on her profile details (location, contributor status, etc.). The reviews that Molly/travel_gem submits are configured by the options the system makes available: six specific categories (Value, Location, Sleep Quality, Rooms, Cleanliness, Service) to be rated on a five-point scale, a free-text box for open-ended comments, and the ability to upload photos. Similarly, the data sent by TripAdvisor to Molly/travel_gem have been materially configured by the algorithms analyzing trends in TripAdvisor's review database. These have been automatically rendered into email messages to visually highlight Molly/travel_gem's reviews and their influence in relation to other reviews and users of the website.

Our findings show that services and service innovations cannot be realized without processes of materialization that draw together and thread through tangibility and intangibility, agency and structure, words, things, and deeds. Experiencing hospitality through the situated practice of travel is entirely entangled with the materialization of service. The quality of service encounters — what makes each one different — depends upon intra-action and specific boundary-making material-discursive practices. So, for example, when Molly was booking travel she wanted facilities for kids included, but was not bothered by the art on the walls. When she stayed at a hotel, the noise from the flight path mattered to her, but it might not to others. Carl makes the positive response to housekeeping an occasion for additional rewards, while the negative comments elicit specific remedies to fix facilities and reassure demoralized staff.

If we call out the entanglement of material-discursive practices instantiated in Figure 3, we find that TripAdvisor not only tells travel_gem that she has made a difference but also gives her grounded evidence of relationality: her review practice is engaging travel_gem with travelers “around the world,” she is part of some “thing” that has resulted (so far) in millions of reviews. She feels that she is leaving something behind, a “contribution” that goes on performing, long after she has stayed at the hotel or entered her review on the TripAdvisor webpage, and that not only changes minds but influences booking decisions and ratings. Through her practices, she is making a “material difference” to the priorities that are created during the search process, the position of the hotel on the Popularity Index, the service experience of other travelers and the

enactment of hospitality by hotel staff. By computing and displaying Molly's engagement with the website and the response of others to her reviews, TripAdvisor works to solicit more contributions from users such as Molly. By using member activity data in the design of their reputation lever, TripAdvisor attempts to mitigate the tendency for people in the crowd to use anonymity as a cloak for potentially offensive graffiti-like statements (Levmore 2011) and a particular kind of (unverified) accountability in their review practices.

In the travel practices highlighted above, there were many sources and forms of information, but we can say that the format of TripAdvisor proved pivotal and became integral to the formulation of knowledge enacted. The expectations and experiences of travelers such as Molly and hotel staff such as Carl, Monisha, Stella, and Mandy are thoroughly entangled with the material-discursive practices that constitute online systems such as Google and TripAdvisor. Such systems are deeply dependent on two key elements that have enabled the service innovations underlying web services and social media: automated computations (algorithms) and large numbers of users (crowds). As Fishkin (2010) notes "The collective 'users' of the Internet (The Crowd) create, click, and rate, while mathematical equations add scalability and findability to these overwhelming quantities of data (The Algorithm)." We turn now to a consideration of these two elements.

Considering Algorithms and Crowds

A number of scholars have begun to examine the implications of increasing dependence on algorithms and crowds for the production and delivery of services. For example, Galloway (2006) characterizes these developments as the rise of "algorithmic culture," while Lash (2007) writes about "algorithmic power." Beer (2009, p. 990) examines the "increasingly powerful and active technological environments that operate without the knowledge of those upon whom they are taking an effect" — environments that Thrift (2004, p. 187) refers to as "performative infrastructures." Such phenomena are particularly difficult to study, as Graham (2005, p. 576) indicates:

Given the inevitably confidential, proprietary and highly technical nature of the core algorithms that now socially sort so many key social domains, what research techniques and paradigms can offer any genuine assistance here? Clearly, the research challenges here are considerable.

We believe that notions of sociomateriality may be particularly helpful here.

Algorithms

Algorithms are a set of step-by-step instructions to achieve a desired result in a finite number of moves. Algorithms act, they *do* things. They form the basic ingredient of all computer programs, telling the computer what specific steps to perform in what specific order with what priority or weighting so as to accomplish a specific task, such as computing taxes or retrieving data about a customer. Common algorithms in use today perform tasks such as calculating, coding, classifying, filtering, finding, optimizing, ranking, ratings, routing, scheduling, searching, sorting, storing, and verifying. Algorithms are increasingly performing most online service innovations, and thus it is useful to consider the entailments of their constitutive role.

Zysman (2006, p. 48) has argued that the rise of algorithms in service innovation represents what he calls “the fourth services transformation.” He maintains that after phases that saw financial engineering, changes to consumer and business purchasing, and the conversion of unpaid, typically female-dominated occupations into commercial services, we now have a “fourth service story” centering on digital or algorithmic transformation (Zysman 2006, p. 48):

Service activities themselves are changed when they can be converted into formalizable, codifiable, computable processes with clearly defined rules for their execution. This is an algorithmic service transformation facilitated by IT tools.

A body of literature on the implications of algorithms for organizing is emerging, for example the enactment of “algorithmic configurations” explored by Callon and Muniesa (2005) in the marketplaces of financial services — forms of ordering work that are enacted by the distributed and mutually constituting calculative agencies of humans and technologies. Work by Mackenzie (2006) highlights that while many possible orderings and actions may be encoded, for any given situation a specific algorithm expresses and reinforces one ordering at the expense of others. While algorithms are often considered mathematically and formally, this abstraction is artificial and temporary because it is practice that enlivens algorithms and activates their consequences. Such an understanding directs our analysis to the definitional and boundary-

making implications of algorithms as performed in practice in specific times and places. As Mackenzie (2006) notes,

[C]ode as expression and code as action never coincide fully ... code, the material that lies at the core of software, is unstable because it is both expression and action, neither of which are materially nor socially stable. In saying something, code also does something, but never exactly what it says, despite all its intricate formality.

A sociomaterial perspective helps us see the performance of algorithms as configuring online services through the material-discursive practices that include some things and exclude others, and which make some things explicit and others not. Hodder (2009) writes:

The ethical issue with algorithms and information systems generally is that they make choices about what information to use, or display or hide, and this makes them very powerful. These choices are never made in a vacuum and reflect both the conscious and subconscious assumptions and ideas of their creators.

Drawing on Amazon as an example, Hodder points to the various algorithms used to classify, rank, sort, and recommend products. She argues that these technologies are substantively shaping the service landscape experienced by consumers:

Amazon is using algorithms, which rely on their classification system, with various statistics like “Sales Rank” to rank products in search results on the site. These algorithms and classifications have points of view.

Returning to our example, TripAdvisor’s website currently hosts over 100 million reviews and opinions, which serve as input to TripAdvisor’s primary algorithm — the “Popularity Index.” For each hotel, TripAdvisor posts all the user reviews and ratings produced for that hotel, along with that hotel’s ranking on the Popularity Index. This numerical ranking is a calculated score that rank orders all hotels within a geographical region. While Google made its initial PageRank search algorithm public (it was part of a Stanford doctoral dissertation), it has subsequently incorporated hundreds of additional criteria for determining page rankings, all of which are now kept secret for competitive reasons as well as to deter people attempting to game the results.² Similarly, TripAdvisor does not disclose the details of its Popularity Index, simply noting on its

² http://en.wikipedia.org/wiki/Google_Search (retrieved July 5, 2013)

website that this proprietary algorithm “incorporates traveler ratings to determine overall traveler satisfaction.”³

Algorithms require that the items being compared are commensurable — standardized with stable and defined properties that make comparability and calculation possible. User reviews on TripAdvisor are both subjective and idiosyncratic, reflecting the personal experiences with hotels that make their insights so valuable to fellow travelers. By definition, the Popularity Index ignores these subjective reviews, focusing instead on user ratings — the quantitative score (out of 5) given by users to six categories, the meaning of which is not defined. Ironically this ranking only draws attention to the interdependencies at work; the temporary order brought about by the ranking algorithm produces a particular point of view or boundary-making cut on the phenomenon. This eradicates idiosyncrasies and conflates differences in user reviews, algorithmically enacting a standardized view that excludes vital relationships and context details that help make sense of the review as part of the process of travel.

Striphas (2010) notes that by nature of how algorithms work — through quantification and aggregation — the results produced exist “at least one level of abstraction beyond the [activities] that first produced the data.” He suggests that this opacity generates “a deceptive aura of objectivity.” Indeed, part of the power of rankings is their capacity to present themselves as objective fact. They intimate that they represent the truth. TripAdvisor’s slogan, for example, is “Get the Truth, Then Go.” It describes its ranking algorithm on its website as follows: “Unlike other sites that simply rank a hotel by price or hotel class, our Popularity Index truly reflects what real travelers [...] are saying.” As with other online service providers, TripAdvisor keeps the ranking algorithm confidential. As a result, to paraphrase Roberts (1991, p. 359), it “imposes *its way of seeing*, without being able to be seen” [emphasis added].

To the extent that more and more online services are increasingly relying on user-generated content that is manipulated algorithmically, the general lack of transparency of algorithms is

³ http://www.tripadvisor.com/help/how_does_the_popularity_index_work (retrieved July 5, 2013)

problematic. It shifts the forms of influence and power that are performed by algorithms (Lash 2007). Striphas (2010) refers to these developments as the “black box of algorithmic culture”:

In the old cultural paradigm, you could question authorities about their reasons for selecting particular cultural artifacts as worthy, while dismissing or neglecting others. Not so with algorithmic culture, which wraps abstraction inside of secrecy and sells it back to you as, ‘the people have spoken.’

In a similar critique, Kevin Slavin, computer game designer, has commented on the “algoworld, the expanding space in our lives that’s determined and run by algorithms.” As he noted in his recent TED talk (2011):

We’re writing things that we can no longer read and we’ve rendered something illegible and lost the sense of what’s actually happening in this world that we’ve made.

But as Introna (2013, p. 14) reminds us, the issue of what algorithms do lies not with the details of the algorithms in isolation, but in their incorporation within specific sociomaterial practices.

Crowds

Social media would not function without the active participation of millions of users who contribute content — a practice that is often termed crowd-sourcing. The algorithms constituting systems such as Amazon, Netflix, TripAdvisor, and YouTube are intimately dependent upon large numbers of individuals acting in particular ways, for example, creating and viewing content, rating and recommending content, etc. This “crowd” has drawn the attention of commentators many of whom refer to collective creativity or “wisdom of the crowd” (Benkler 2006; Jenkins 2006; Surowiecki 2004). While the term “crowd” typically evokes a nameless group of people in close proximity such as one may encounter in a football stadium, the notion of the “crowd” in this context differs from it in many ways. It also differs from the term “mass market,” often evoked to describe a large general group of consumers. In contrast, the “crowd” implicated in user-generated content websites and online service provision refers to the distributed, online, virtual, diverse, anonymous/pseudonymous, and fluid set of individual participants whose engagement with a website is materially configured by the algorithms at work on that site. This crowd is constituted by material-discursive practices — both those of the

participants and those of the website provider. It is a performative, material enactment that produces and consumes certain forms of user-generated content.

In the case of TripAdvisor, the crowd is constituted by the more than 44 million members who have posted the more than 100 million reviews. This crowd has played (and continues to play) a vital role in the success of the TripAdvisor service innovation within the hospitality sector. The crowd's ongoing contributions — both as producers of content (traveler reviews and opinions) and as providers of revenue as they click on links that supply an income stream to the company — maintain the viability of the TripAdvisor service. Indeed, member points of view are both featured and favored, and this is reflected in TripAdvisor's mission, "enabling travelers to plan and have the perfect trip." As one of the hoteliers in our study observed, TripAdvisor is a service "by travelers, for travelers."

Whether they are casual or active members of TripAdvisor, all the 'information' posted by users (subjective ratings and reviews) serves as input to the website's algorithms which filter, manipulate, compute, and render the content into the form that is visible online. TripAdvisor's click-through business model depends upon user-generated content to draw commercially valuable 'traffic' to the website, facilitating opportunities for these users to click on links that lead to other travel websites (such as Expedia, Hotels.com, Booking.com, and Hotels4U) where additional information and booking engines support the actual purchase of travel products and services. In this sense, people engaging with TripAdvisor are in a deeply relational practice as 'con-ducers' —producers and consumers that promote and emote — actively helping to bring social media into being as well as helping to ensure its value over time.

Describing this emergent notion of the crowd, Van Dijck (2009, p. 54) has observed:

When *Time* hailed You as the 'Person of the Year', the magazine paid tribute to the millions of anonymous, productive contributors to the web – a tribute akin to the badge of honour bestowed upon the unknown soldier. This powerful but contrived metaphor has come to define the concept of user agency as it dissipated into academic and professional discourses.

The notion of user agency has been framed as participatory engagement, in contrast to the passive recipients of earlier media (Jenkins 2006). However, as van Dijck (2009, pp. 43-44)

observes, this is misleading, as not all in the crowd are active contributors. Indeed, surveys suggest that only about 13% of participants to online systems make contributions, while the rest are passive recipients of content provided by others (van Dijck and Nieborg 2009). Given participation is increasingly regarded as a viable basis for action, chosen over formal expertise as a basis for reconfiguring practice, it is important to understand more carefully what constitutes it, how it is performed, and with what implications.

As we saw above, the algorithms designed and deployed on these websites play a powerful role in constituting the kinds of practices that may be enacted by the crowd. They shape the materialization of TripAdvisor's service for its users. Van Dijck (2009, p. 43) advocates problematizing the notion of users as primary "creators and arbiters of media content," and asking "what role do platform providers play in steering the agency of users and communities?" Content management practices, database designs, algorithms, network structures, etc., all serve to configure particular services and outcomes. Furthermore, the crowd does not just "generate content" for public display on the website. Perhaps even more importantly, in the contemporary online service world, these users are (often unwitting) providers of digital data to the website, as van Dijck (2009, p. 47, 49) argues:

[I]t is crucial to understand the new role of users as both content providers and data providers. Besides uploading content, users also willingly and unknowingly provide important information about their profile and behaviour to site owners and metadata aggregators. Before users can actually contribute uploads or comments to a site, they usually have to register with their name, email address and sometimes add more personal details such as gender, age, nationality or income. Their subsequent media behaviour can be minutely traced by means of databots. More importantly, all users of UGC [user-generated content] sites unwittingly provide information because IP addresses – the majority of which can be connected to a user's name and address – can be mined and used without limit by platform owners. ... [And] the bottom line is that users have no power over data distribution.

Accounting for the dynamics of the crowd in studies of service innovation would thus need to consider the material-discursive practices of content generation and distribution, the role and performance of algorithms in shaping these practices, and the mechanisms through which digital data on user behavior is captured, stored, and used to inform further automated processes, whether customization, recommendation, observation, tracking, etc.

Implications

In this paper, we have emphasized the importance of understanding service as constituted in practice through specific materializations that configure activities, bodies, and artifacts in particular ways in particular times and places. We have suggested that sociomateriality may offer a useful lens for exploring such materiality and performativity, particularly as service innovations become more pervasive and influential in contemporary organizations. We considered this in the context of online rating and reviewing systems, examining how crowd-sourced content is configured by algorithms to shape actions, decisions, management, and changes that become manifest in practice. We focused on examples in the hospitality sector, looking at how the specific material enactments of hotel reviewing and rating on TripAdvisor made a difference to the performance of service on the ground within hotels.

Theories are lenses that focus us on one thing rather than another and sociomaterial approaches have risen in importance because they put capacity for action and entanglement in practice on our agenda. As we saw in the example of Molly's reading and contributing of hotel reviews, these practices are configured by the TripAdvisor system. By making the turn to *material-discursive* practices, we recognize that what we are studying is always materialized in practice, and that specific materiality makes a difference to what is enacted. Such an approach challenges us to reframe our research questions to include the specific sociomaterial conditions in which service innovations take place. Studying practices is always challenging and requires time-consuming ethnographic inquiries in the field. The "inscrutability and executability" (Introna 2013) of online practices involving algorithms and databases creates two further challenges. First, they are typically not available for study. Second, separating them out and analyzing them in isolation does not help us to understand their performativity in practice. Nevertheless we can and should analyze them in sociomaterial practice on screens and on the ground.

Our research in the hospitality sector has revealed that online rating and ranking — as performed through the materiality of algorithms and crowds — is entangled with a significant

reconfiguration of interests and relations between hoteliers and travelers. As expectations and experiences are transformed, they can change power dynamics and economic control. For example, the rise of social media and user-generated content within the travel sector is generating an important shift in power and influence from producers to consumers. Such shifts may effectively be studied by examining how material-discursive practices re-draw boundaries, changing inclusions/exclusions and making a difference to who participates, how, and with what consequences. Such an approach encourages us to call out the materialization of power and interests in practice, rather than confining our research to discourses centered on terms such as “adding value” which sound neutral but seldom are. Attending to how services are materialized and performed in practice may be useful not only for understanding shifts in knowledge, relationships and power within the hospitality sector, but also for opening up avenues more broadly for future research in information systems and organization studies.

The sociomateriality approach also draws out attention to consequences in practice. Services are not only performed in practice, but they are also performative, making a difference to what is produced, to the relationships and outcomes generated in practice. In the case of TripAdvisor, for example, the algorithm and the crowd are central to its operational success and powerful influence within the travel sector. They are also central, however to the difficulties the website has experienced in managing the scale of its crowd-sourced content, monitoring the quality of its members’ contributions, and having to frequently update its algorithms to remain innovate and competitive. These ongoing efforts by TripAdvisor to alter its services can be seen as material-discursive practices that continue to codify, manipulate, and compute the content on the website. The service produced and delivered by TripAdvisor is an ongoing enactment, entangling and entailing activities, bodies, and artifacts in sociomaterial practices.

The algorithms constituting the online services we interact with everyday — Google, YouTube, TripAdvisor, etc. — don’t just search and sort reality, they also create it. However, such algorithms can only codify, quantify, and compute so much. The rest of service overflows this in practice, as we saw in the details of our vignette. Understanding the construction and operation of

algorithms as sociomaterial practices can help us investigate these differences and overflows, inquiring into the performative implications of systems that constitute reality through technologies that we cannot see or understand. As van Dijck (2010, p. 74) notes about search engines, “Without a basic understanding of network architecture, the dynamics of network connections and their intersections, it is hard to grasp the social, legal, cultural and economic implications of search engines.” The same applies to the algorithms that actively produce the online services that are becoming more and more integrated into our organizational and personal activities. Much future research work remains to be done to develop a detailed understanding of the constitutive and performative role played by algorithms and the crowd in online service innovation.

Furthermore, the complexities surrounding online services encompassing the algorithm and the crowd intensify relations of timing and placing: not only does user-generated content dynamically refresh databases (e.g., an average of 25 new contributions are posted to TripAdvisor every minute) but situated experiences are shared, achieving an almost global reach. These ongoing reconfigurations amplify dynamics of change that are otherwise enacted through more gradual practices. Indeed intra-action through time — histories, legacies, and memories — is critical to studying materialization in practice. This prompts the question — what kind of realities are emerging in the phenomenon of service? Much future research is needed in this area.

A sociomaterial approach allows us to see that the dynamics of contemporary service innovations are material-discursive practices. Such an approach emphasizes the relationality, materiality, and performativity entailed in the crowd-sourced algorithmic transformations emerging as central in contemporary online service innovation. By focusing on how boundaries are drawn, how phenomena are configured, and what realities are performed, this approach can provide insights into the intimate interdependencies involving the dynamic relationships of algorithms and crowds. Such an analysis can thus offer insights, not into separate entities and their interdependencies, but the dynamic tensions and intra-actions that produce — to make a play on Barad’s term — ‘intra-dependencies’ — which make a difference to the kinds of services and organizational realities that are enacted.

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Figure 1: Email from TripAdvisor regarding Specific Review



Figure 2: Email from TripAdvisor regarding Member Update

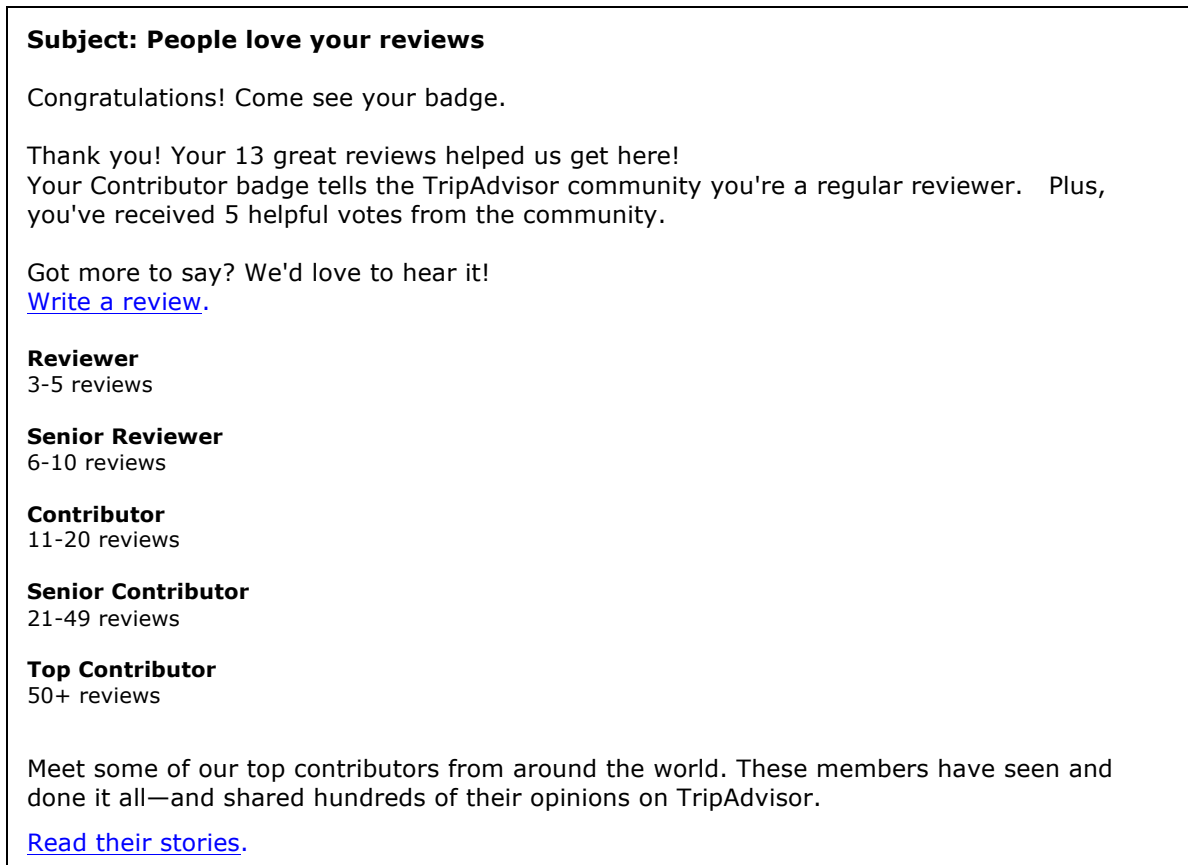


Figure 3: Email from TripAdvisor regarding Member Review Update

Subject: Your review update from TripAdvisor

Someone's been reading your reviews August 2011

Your opinions have made a real difference. Thank you!

Your recent reviews

REVIEW	TOTAL READERS*	HELPFUL VOTES	DATE
Oldebourne House Hotel	1,136	4	June, 2011
King Leopold Cafe	33	4	June, 2011
Blu Hotel	22	1	June, 2011
The Merrimac Inn	11	0	June, 2011

[Review another place](#)

Your readers

72% of your readers are in United Kingdom
11% of your readers are in Greece
5% of your readers are in Israel
12% of your readers are in other countries

About you

MEMBER NAME	travel_gem
MEMBER SINCE	August 2, 2009
LOCATION	Louisiana
TOTAL REVIEWS	13
BADGE LEVEL	Contributor

Write 8 more reviews to earn your next badge

TOTAL READERS*	1,202
TOTAL HELPFUL VOTES	8

[Update your info](#)

***"Total readers" includes everyone who has seen your TripAdvisor reviews during the past 12 months.**