Performative sensibility and the communication of things[1]

Sensibilidade performativa e comunicação das coisas

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ABSTRACT

This article affirms the social character of objects and highlights the differences between sociotechnical networks of everyday objects and those of digitally-augmented objects, which characterize the Internet of Things (IoT). This difference between automation processes and IoT networks is called *performative sensibility* (PS). We also show that PS is not a technical characteristic of sensors and actuators but a property that places the digitally-augmented object in a broader communication network through algorithmic performances and procedures. We explore how PS can be seen as a fundamental key to a conceptual model of *the communication of things*, including the procedural narratives of Fibit Charge HR2.

Keywords: Performative sensibility, communication of things, Fitbit, Actor-Network Theory

RESUMO

O objetivo deste artigo é afirmar o caráter social dos objetos e apresentar o que diferencia as redes sociotécnicas de objetos cotidianos daquelas de objetos aumentados digitalmente - as quais caracterizam a *Internet das Coisas*. Denominamos essa diferença de *sensibilidade performativa*. Mostraremos que a sensibilidade performativa não é uma característica técnica de sensores e atuadores, mas uma propriedade que amplia o objeto de modo infocomunicacional em uma rede de comunicação também mais ampla, a partir de performances e procedimentos algorítmicos. Destacamos como essa sensibilidade performativa pode ser vista como um elemento fundamental para pensar um modelo de *comunicação das coisas*, explorando as narrativas procedimentais da Fitbit Charge HR2.

Palavras-chave: Sensibilidade performativa, comunicação das coisas, Fitbit, teoria ator-rede

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IN 2016, FITBIT, Xiaomi, Apple, Samsung and Garmin sold 23 million physical activity monitors and became the five largest companies in the global wearables market (IDC, 2016). These devices, supported by the widespread discourse that they promote an optimized lifestyle, constitute the broader phenomenon known as *wearable technology* and are part of the network of objects that make up the Internet of Things (IoT). "Wearables" collect biometric patterns by a continuous connection with the bodies of the users wearing them.

The term Internet of Things (IoT) was proposed in 1999 by Kevin Ashton to describe the process by which the movement of products was monitored with radio frequency tags (RFID) coupled to objects. IoT can be defined in many ways (Atzori; Iera; Morabito, 2010; Cerp, 2009; Giusto et al. 2010; Uckelmann et al. 2011, Martin, 2015; Brereton et al., 2014; Greenfield, 2006; Greenwald, 2015; Howard, 2015; van Kranenburg, 2008), but the only idea common to all the definitions is an Internet-based network in which physical and digital objects are instrumentalized with sensors that have a unique identification number and can communicate over networks. These objects sense the world, produce data and act autonomously and independently of direct human intervention. The particular way of *sensing* the world, communicating and acting on other objects is what distinguishes the IoT. We call this quality *performative sensibility* (PS) (Lemos, 2016).

As we shall see in the case of *wearables*, PS goes beyond the mere communication of biometric indices (temperature, blood pressure, blood glucose levels etc.), the provision of information on UV radiation or CO2 levels in the streets, the amplification of audio signals (listening devices) or the control of irregular heartbeats (pacemakers); all of which are common to rudimentary automation processes. Unlike analog or physical-first[2] objects (Greengard, 2015), the PS of the IoT is not limited to capturing or merely presenting indicators but, as we shall see, it also constructs narratives, suggests actions and produces profiles from the extracted data.

Wearables are an example of this PS of objects in the IoT, as they illustrate the relation between digitally-augmented artifacts, the sociotechnical networks that instrumentalize them and the users' bodies. Promoted by the discourse of self-improvement and control through the quantification of habits (Nascimento; Bruno, 2013; Lupton, 2014), the agency of this instrumentalization goes beyond the evocative property of objects (Turkle, 2007). Smart wristbands (Fitbit, Jawbone or Xiaomi) evoke a vision of healthy bodies not merely by the effect directed at the materiality of the object, but as a result of a personal narrative generated by the processing of the captured data.

[2] For Greengard (2015), physical-first objects are those that are not digitally instrumentalized. A paper book is an example, while an e-reader is a digital-first object.

With the PS of wearables, body accessories now evoke perceptions, *sense* the body and the outside world, recognize the presence of other bodies and data, and act as smart objects. PS, as a sensible instrumentalization of an object-network, is capable of developing markets and performative habits, building identity profiles and drawing scenarios about the present or the future through the logic of algorithms (Owen, 2015; Danaher, 2016). The performativity that characterizes the sensibility of objects in the IoT is undoubtedly a form of agency (Latour, 2005; Lemos, 2013), but not a generic *sense-react* agency. Performativity is a chain of actions that emerges from the network information processing based on the algorithmic sentience (sensibility) of the object, allowing it to make decisions and act. PS is, therefore, a *performative sensibility* as it can be characterized as a particular way of sensing and acting, which is enabled by computational processing and algorithmic procedures distributed in the network from which it is part.

The consequences of algorithmic mediation between objects in the IoT and bodies have been extensively discussed in the literature. Some studies suggest the use of wearables leads to the construction of models for the standardization of body practices based on the ideals of individual responsibility that underlie the discourses of self-optimization through numbers (Lupton, 2016; Smith; Vonthethoff, 2016; Klauser, Albrechtslund, 2014; Ball; Di Domenico; Nunan, 2016). After defining behaviors, the aim is to produce personal data and feed the servers for the platforms that promote this type of technology (Wright; Harwood, 2012). Body practices focused on producing data are part of a program of digital standardization of bodies based on techniques for changing behavior in the interfaces of wearable computers (Ledger; McCaffrey, 2014; Lyons et al., 2014; Lewis et al., 2015; Mercer et al., 2016). They change the notion of health and production (Rail; Jette, 2015) at the same time as they turn body micropractices (Fuchs et al., 2013; Fotopoulou; O'Riordan, 2016) into commodities, into data practices (Lupton, 2015). The result is the production of new models of subjectivity (Papacharissi, 2010; Papathanassopoulos, 2015).

In this article, we chose the Fitbit Charge HR2 as the empirical object. This device is the successor to the most popular product sold by Fitbit, the largest company in the global wearables market, with 23% global market share in the third quarter of 2016 (IDC, 2016) and 16.9 million active users in 2015 (Pai, 2016). We also analyze the brand discourses used to advertise the smart features of Charge HR2 and the technical characteristics advertised on the official website[3]. The promotional narratives were classified according to the most frequent arguments.

[3] The material analyzed was taken from the webpage advertising Charge HR2, available at: <https://bit.ly/2bTJAnJ>. Viewed: 9. oct. 2018.

To analyze the technical features, we drew up a descriptive matrix with the following technical criteria: the technical objective of the feature advertised, the source of the data used, and the types of communication interfaces involved. The results were tabulated and analyzed with ATLAS.ti. The aim of this approach was to investigate the correlation between the arguments used to promote the PS of Charge HR2 and the objective of the technical features that instrumentalize it. In parallel, the most common communication interfaces and sources of data were identified.

PERFORMATIVE SENSIBILITY

Social studies show the understanding of objects has changed and that these are now considered important mediators for the analysis of any social fact. This turnaround can be called object-oriented ontology (Harman, 2011), actor-network theory (Latour, 2005) or the social agency of objects (Bennet, 2010; Engeström, 2008; Knorr-Cetina, 1997; Winner, 1980). Each of these terms acknowledges, in its own way, the role objects play in the social domain (Dourish, 2016; Lemke, 2015; Lemos, 2013).

If every object is social, changes in the *quality* of an object affect different domains (economic, political, cultural and organizational). Any innovation in, or implementation of, a sociotechnical network produces rearrangements. Changes occur when a speed hump is built near a school, when public lighting is installed or when everyday objects contain embedded processors and sensors that are connected to each other electronically. The former example is what constitutes the IoT. The fundamental change lies in the quality of objects, which are now digitally instrumentalized. For example, when a smart wristband that has sensors and can communicate is connected to specific platforms and databases, it leads to actions by the subject, providing the basis for health-oriented actions and producing a new body discourse (Lemos; Bitencourt, 2017). The same can be said of a garbage can, a lamppost, a chair, a fridge, a thermostat, a light etc.

Transformation through the informational and communicational capability of objects is becoming more widespread with the IoT. Therefore, it is appropriate to investigate this transformation and identify the principle upon which it is based. To this end, we will consider Performative Sensibility (PS) to distinguish the IoT from Web 1.0 or Web 2.0. PS can be considered an assemblage of specific sensibility and performance enabled by the production and interpretation of information captured from the environment, processed and distributed through datafication processes (Mayer-Schönberger; Cukier, 2013; Van Dijck, 2014; Kennedy; Poell; Van Dijck, 2015). PS is the new quality of a network-object fitted with sensors whereby its performativity (now digital and algorithmic) produces mediations (agencies) in other objects, institutions and/or humans.

PS is the "sensorized"[4] property (Smith, 2016), the result of a network of objects that produce contextualized, personalized narratives through sharing, processing and aggregated analysis of data. Commonly known under the name *smart*, an abbreviation for "self-monitoring analysis and reporting technology" (Rothberg, 2005), the PS of objects in the IoT is not merely a result of their connection with the Internet or of algorithms, sensors or actuators in isolation, but of a particular type of knowledge derived from reports and feedback developed by the procedurality (Bogost, 2007, 2008) of the information systems that are now part of the materiality of these objects.

[4] Smith (2016) discusses both the phenomenon of embedded sensors that extract data and act on everyday objects and the consequences of the agency of these devices.

PS is an actor-network (Latour, 2005; Lemos, 2013). With the IoT, objects endowed with PS are connected to each other in an extensive network of actors. PS emerges from a chain of different actions and can be detected in the flow of action, rather than in isolated points in the network. Thus, traces of PS can manifest differently in a network, from capturing data by a sensor, through the activity of actuators to affect other objects, the production and communication of data in a network, IoT platforms (Zdravkovic et al., 2016), business models and analysis of the data generated (big data analytics) to the discourses of users, companies and government. PS is, therefore, not just a characteristic of the sensors/actuators coupled to real and/or virtual objects.

The sensibility of PS is procedural (algorithm-based) rather than reactive, such as the objects in the 20th century of electromechanical devices and industrial automatism. Objects endowed with PS are sentient, i.e. they are aware of themselves and of the environment and communicate with each other autonomously in a digital network. Their performativity is systemic and algorithmic, producing changes in a variety of actors. It occurs when action is produced based on data capture, transmission and storage, and it can be understood analogously to the "performative utterances" by Austin (1962), which are acts that do something, that provide broad agency and mediations, such as saying "I hereby declare you husband and wife," triggering a series of actions related to marriage. In the case of the IoT, this performativity emanates from the digital and algorithmic sensibility of the sensors and actuators coupled to the objects, generating actions in an extensive system. Therefore, the sensibility of PS is procedural (Bogost, 2007, 2008; Manovich, 2013) and the performativity, dynamic.

To understand the processes involved in the emergence of PS and how it acts, the capture of sensations by objects and the production of systemic actions and discourses must be considered first. Consequently, PS is not a technical attribute restricted to the object, as its algorithmic performativity requires multiple connected actors collecting, sharing, processing and analyzing data that will be used to build the various layers of information in a particular association. It is an *actant* in a complex network (Latour, 2005), which, depending on the case, involves companies, governments, data visualization interfaces, apps, user communities, algorithms, systems, servers, usage policies, APIs etc. As decisions are based on the analysis of the data generated, the action triggered by PS is dynamic, intersystemic, predictive and preventive. In the IoT, every object is a user of the information system in which it is located (Nansen et al., 2014).

To give an example of PS, we will take a look at a typical example of a smart city project (Calzada; Cobo, 2015; Kitchin, 2016). The smart garbage cans in Dún Laoghaire, Dublin, are fitted with sensors and connected to an extensive system that identifies the amount of garbage in each can. The garbage cans send an SMS or e-mail if they are full, capture solar energy to supply the compactor, which condenses the garbage and warns if there is a problem with the sensors or with the mechanism. The PS algorithm acts on a large system, identifying the best route for the garbage to be collected, building up data on the locations where the garbage cans are always empty or full and allowing thus a better view of the whole system through the dashboard, i.e. it instrumentalizes garbage management. PS allowed the human resources and materials involved to be reallocated and led to a reorganization of the department in the county council. PS is not limited to the sensibility of the sensor or to the immediate action of the actuator in the garbage can, but extends throughout the whole network, mediating an extensive process of communication between things in the public waste collection service (Pticek et al., 2016; Karimova; Shirkhanbeik, 2015; Mulani; Pingle, 2016).

The same occurs to all objects in the IoT, although the reach and complexity of the action associated with PS can vary according to the size and heterogeneity of the network to which the objects belong. It is in the network that everyday objects capture, process and communicate data taken electronically from the environment, producing an algorithmic agency in multiple points in the network. A sensor without a connection only produces a reactive sensibility in the object. However, when the sensor is connected to a network, the processing and algorithmic agency of the systems transform the reactive object into a sentient and performative one from the perspective of PS. Similarly, without the sensor in the object, the whole network loses its meaning. As the variety of objects in the IoT is increasing (examples range from wearables to medication – ingestible sensors[5]), PS may affect many different aspects of contemporary culture and social life, with far-reaching implications[6] that have been acknowledged by the Federal Communications Commission (FCC, 2016).

[5] The Proteus platform and Pillcam are examples of ingestible sensors. Available at: <http://www.proteus.com>; <http://pillcamcolon.com>. Viewed: 9 oct. 2018.

[6] According to the McKinsey Global Institute, the IoT could have an economic impact of up to $ 11 trillion by 2025 and the number of things connected to the Internet is expected to exceed 50 billion by 2020. There will be 6.58 devices connected for every person in the world (Sowe et al., 2014). Available at: <https://mck.co/1oNkWpa>. Viewed: 9 oct. 2018.

Cardio Fitness Level in the Fitbit Charge HR2

The types of digital instrumentalization produced by objects vary according to the specific nature of the data captured, the network they connect to and to the projected materiality of the object (a digital teacup does not extract the same type of data as smart trainers). To illustrate the actions of PS in the IoT, we chose the Charge HR2 wearable device from Fitbit, as the company was the market leader from 2007 until the first quarter of 2017, when its global market share dropped from 23% to 12% (IDC, 2017). Although Fitbit recently lost its leadership to Xiaomi and Apple, the company still has the largest user base (50 million) and a strong presence in the corporate wellness market (IDC, 2017). According to another IDC report (2016), Fitbit shipped 5.3 million units in the third quarter of 2016, and the number of active users reached 16.9 million in 2015 (Pai, 2016).

Fitbit sells products and services designed specifically to optimize physical activity through wearable monitors (Fitbit Inc., 2015). The products and services portfolio consists of seven wearables; a smart scale; an exclusive social network with around eight million active users[7]; the Fitbit wellness program[8], a corporate service for managing workplace health adopted by 70 of the Fortune 500 (Cipriani, 2015); Fitbit Group Health, a Fitbit consultancy service for corporate wellness clients (Fitbit Inc., 2016b); and a division between partners with companies and digital health services (Fitbit Inc., 2016a)[9].

[7] Available at: <https://bit.ly/2uIcxPs>. Viewed: 9 oct. 2018.

[8] Available at: <https://www.fitbit.com/group-health>. Viewed: 9 oct. 2018.

[9] According to the Springbuk report (2016), the use of Fitbit devices in corporate environments led to a 45% reduction in individual employee health costs.

Charge HR2 was launched at the end of 2016 as a replacement for Charge HR, which had become the brand's most popular device following its launch in 2015[10]. Designed as a rubber bracelet with replaceable straps, Charge HR2 has a dynamic touch-sensitive display that allows the user to monitor in real time his heart rate, the number of steps taken, the total distance run, and the number of calories burnt. When it is connected to a smartphone, Charge HR2 allows the user to see calls, texts and calendar alerts. The user's heart rate is read continuously with PurePulse HR (a sensor and proprietary algorithm[11]), which provides accurate information that can be used to generate indexes related to sleep quality and calorie burn in non-sports activities, for guided breathing sessions and for guidance on physical performance based on the user's profile.

[10] Available at: <https://www.fitbit.com/charge2>. Viewed: 9 oct. 2018.

[11] Available at: <https://www.fitbit.com/purepulse>. Viewed: 9 oct. 2018.

Wearables such as Charge HR2 are not merely reactive objectives (such as pacemakers and hearing aids, which involve general automation processes) but rather performative objects. The systems and interfaces that make up Charge HR2 are designed to propose actions and direct behaviors based on a body perception shaped by the result of algorithmic decisions and computer processing of large amounts of data. This quality is an example of what we call PS.

Unlike ordinary heart-rate monitors, Charge HR 2 does not just react to body stimuli by measuring, recording and providing raw indexes, but produces a narrative about the user's physical performance with the network of Fitbit objects. This discourse is developed procedurally by the computational processes and algorithmic guardianship of the system and directed at different audiences that make up the brand platform (user, partners, regulatory agencies etc.).

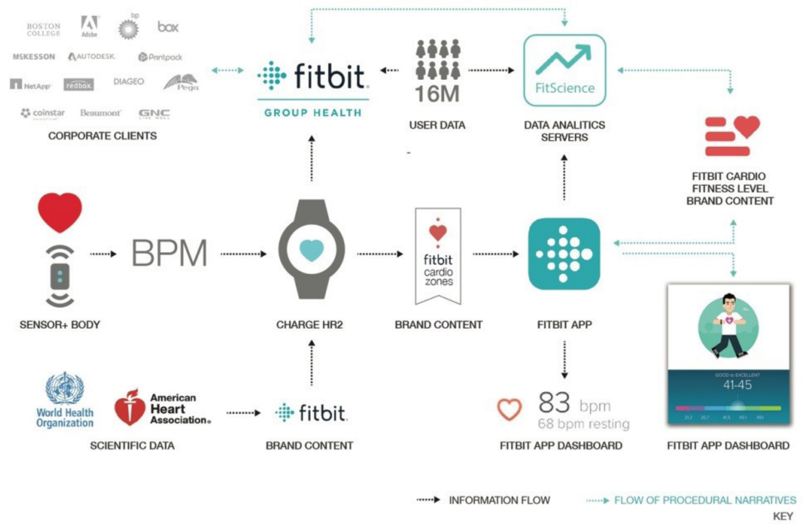

FIGURE 1 – Summary of the data flow during heart monitoring in the Fitbit Charge HR2 and the process of determining the Cardio Fitness Level
Source: Elias Bitencourt

The agency of PS in Charge HR2 is circular and mobilizes different actors both in the sociotechnical network of the device and in the networks to which the device also connects. The action of monitoring heart rate illustrates this circularity (Fig. 1). When Charge HR2 is put on the user's wrist, the PurePulse device detects heart beats automatically and classifies the heart rate into *heart rate zones*, which vary according to the age and sex recorded in the user's profile[12]. When Charge HR2 is synchronized with a smartphone, the raw data and the *heart rate zone* history are sent to the Fitbit servers so that the Cardio Fitness Level (the brand's exclusive health and performance index) can be determined.

The Cardio Fitness Level is based on the comparison between the user's heart rate records and information in his profile and the corresponding values for other clients of the same sex and in the same age group[13]. This profiling is the starting point to classify user's fitness and cardiac performance and provide guidance and suggestions to keep the individual *active and healthy*.

[12] Zones are determined by subtracting 220 from the user's age. See: <https://blog.fitbit.com/how-to-use-your-heart-rate-zones-during-workouts/>.

[13] Available at: <https://blog.fitbit.com/get-to-know-the-new-fitbit-cardio-fitness-level-feature/>. Viewed: 9 oct. 2018.

An exploration and description of Charge HR2

In an attempt to describe the sociotechnical network that instrumentalizes the body perception mediated by PS, we explored the promotional discourses related to the features of Charge HR2, the Fitbit app and the PurePulse algorithm, as well as the implicit aims of the action programs associated with these features. To assess the discourse, we identified the titles and descriptions on the Charge HR2 web page. In all, 48 features were highlighted, of which 20 were associated with the device, 18 with the app and 10 with PurePulse (Fig. 2).

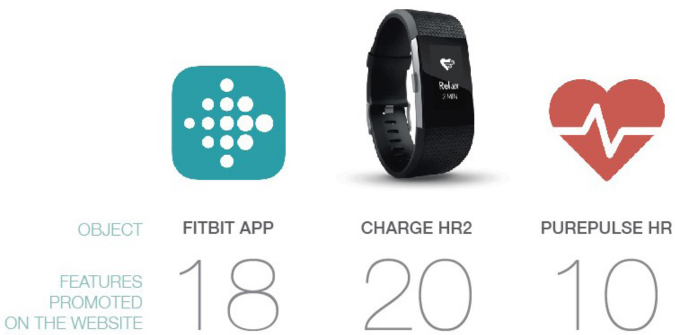

FIGURE 2 – Number of technical features analyzed by object
Source: Elias Bitencourt

The texts were analyzed with ATLAS.ti using focused coding, in which the content is categorized according to the most common topics identified in the texts. The categories created for the analysis were based on two initial questions: 1. What are the arguments used to promote the informational and communicational properties of the object? and 2. What are the technical aims underpinning the features highlighted in the official marketing for the object? These procedures investigated the correlation between the arguments used to promote the PS of Charge HR2 and the aims of the technical attributes that instrumentalize it.

Next, the technical features of the object were analyzed, as well as the processes involved in the development and targeting of the discourse enabled by PS. In this phase, a descriptive matrix was built to identify the communication interfaces used by the Charge HR2 features and the data source used to prescribe the healthy routines suggested by the Fitbit system. The relevant technical details for this were taken from the documentation available on the Fitbit website. The information was classified following the data taxonomy proposed by Kitchin (2014), with data being considered either *captured* (when the source is the actual measurement) or *derived* (when the source is data that have already been processed). The *derived data* category was subdivided into *scientific data* (technical records of scientific studies, institutions and regulatory agencies), *brand content* (a proprietary brand parameter such as Fitness Level, an exclusive measure) and *Fitbit network data* (data processed in the network of objects that make up the platform, such as the wearable-app circuit).

Of 48 technical features highlighted by Fitbit, 38 (79%) allowed body patterns (a record of the user's weight, number of steps etc.) to be continuously extracted or manually recorded, 25 (52%) of them aims to motivate the user to use the device all the time (automatic sleep monitoring, movement alerts etc.) and 16 (33%) features can connect to the Internet and other objects on the network (use of GPS, synchronization with apps etc.). Among the arguments used to promote these features, the ones most frequently associated with the features were "Charge HR2 expands the user's knowledge by providing personal statistics" and "Fitbit tools motivate users to achieve personal goals and inspire them to better themselves" (Fig. 3). The words that appear most frequently in the texts analyzed are *track (er/ers)* (42 instances and a density of 2.6%), *heart* (32 instances and a density of 2%) and *day* (29 instances and a density of 1.9%).

Turning to the different ways information is presented and exchanged (Fig. 3), 41 (85.4%) of the technical features investigated involve procedural interfaces (information exchange based on algorithmic procedures that do not require conscious interaction from the user, such as heart rate monitoring), while 41 features use text interfaces to display data and another 40 (83%) require a network connection to perform the corresponding task (automatic sleep tracking requires synchronization with the app to display the data).

The graphic interfaces and displays are associated with 38 (79%) features and are followed by biometric and performative interfaces (devices involving user interaction that require significant body actions, such as running, going upstairs or sleeping), each with 28 attributes (58%) associated with them. The haptic interfaces (interaction by physical response, vibrations etc.) and gesture-based interfaces (use of a repertoire of gestures and multiple touches to interact with the system) were the technical features that appeared least often among those prioritized by the brand. Only 20 (42%) and 10 (20%) of the functions use haptic and gesture-based feedback, respectively.

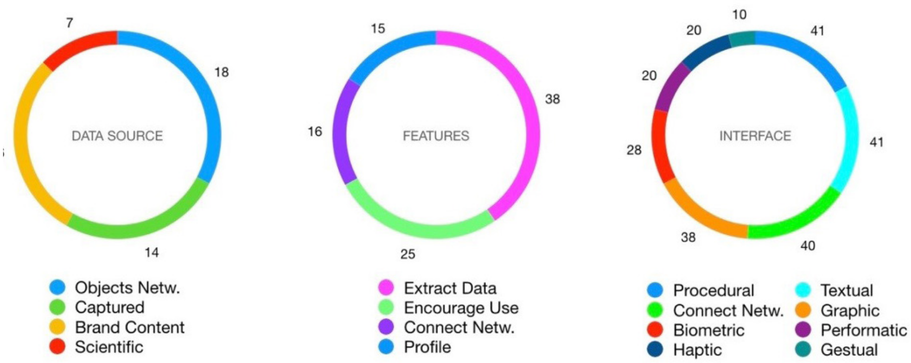

FIGURE 3 – Distribution of Charge HR2 features by data source, function and communication interfaces used

Source: Elias Bitencourt

As to the data source used by the Charge HR2 technical features, the main ones are those derived from the network of Fitbit objects and from the brand content (FIG. 3). Of the 48 features, 42 (87%) use information from data processed by Fitbit apps, devices, servers and users, and 40 (83%) come from Fitbit protocols, measurements and analytics based on client data. Our analysis also revealed that directly captured data are used as reference for 39 (81%) of the Charge HR2 features. Scientific sources were identified for only 23 (47%) of the attributes listed (Fig. 3). No evidence was found in the technical documents analyzed of information flows or aggregate processing of data from scientific institutions. These institutions appear more frequently when they are endorsing the criteria used to treat the information in the system (the parameter of 10,000 steps/day is a WHO recommendation).

The development of procedural narratives

The analysis of Charge HR2 revealed four basic characteristics of the device. The first is that its PS was designed to operate in a network. This is reflected in the preponderance of network interfaces (83%). Most of the features of the object depend, to a greater or lesser degree, on the wearable-app-sensor-platform connection to work; indeed, Charge HR2 cannot be separated from the other objects that make up the network to which it belongs.

The second characteristic is the interdependence of the materiality of the object and the materiality of the digital data. The technical features of the object are only updated when the data circulate in the network and depend, to a large extent, on procedural interfaces. Even the esthetic accessories for Charge HR2 (bands and different finishes) are advertised using arguments that encourage constant use of the device, e.g. "From workouts to nights out, transform your Charge 2 with Classic accessories, Luxe leather bands or Special Edition trackers"[14].

[14] Available at: <https://www.fitbit.com/charge2>. Viewed: 9 oct. 2018.

The third characteristic is that communication between users and devices is mediated by a kind of action-oriented information assemblage produced in the network. Not only does the wearable perceive the body through categories created by the Fitbit system, but the user also perceives himself in these categories and in the narratives developed by the algorithms. In this particular type of proposition, the computer code alternately plays the roles of information producer, means of circulation, language, content, audience and interpreter, suggesting that the main form of writing for the information model produced is circulation in the network. This means that the message registration and construction processes are not characterized by the technic used to inscribe information on the medium, nor by sharing a common grammar between sensors, algorithms and users, but by sharing multiple agencies. Hence, the procedural narratives elaborated by PS are different from those of mass communication models, in which the network is a channel whose role is limited to that of disseminating content.

The fourth aspect is that the Fitbit marketing discourse shows a media contract model whose main source of information is digital data. Not only are the objects used to produce and extract data, but the self-narratives are built using the computational procedures in the system. In this type of contract, the information produced does not come from an identifiable source, but rather combined and updated in the distributed procedurality of the Fitbit network. This implies that the information will vary depending on the requests made by the different audiences in the network, and the contexts in which the extracted data will be used are unpredictable (Fig. 4).

Our empirical findings corroborate the argument that PS is an attribute that distinguishes the agency of objects in the IoT from that of merely automated objects. As illustrated by the analysis of Charge HR2, PS is not an inherent quality of the object, but rather an event that emerges from the associations between multiple actors to occupy a central place in the political, economic and material Fitbit model. In addition, the mediation produced by PS occurs through information, implying that it should be thought of as a communicational device, an actor-network that not only mediates and addresses narratives, but also develops discourses by algorithmic procedurality.

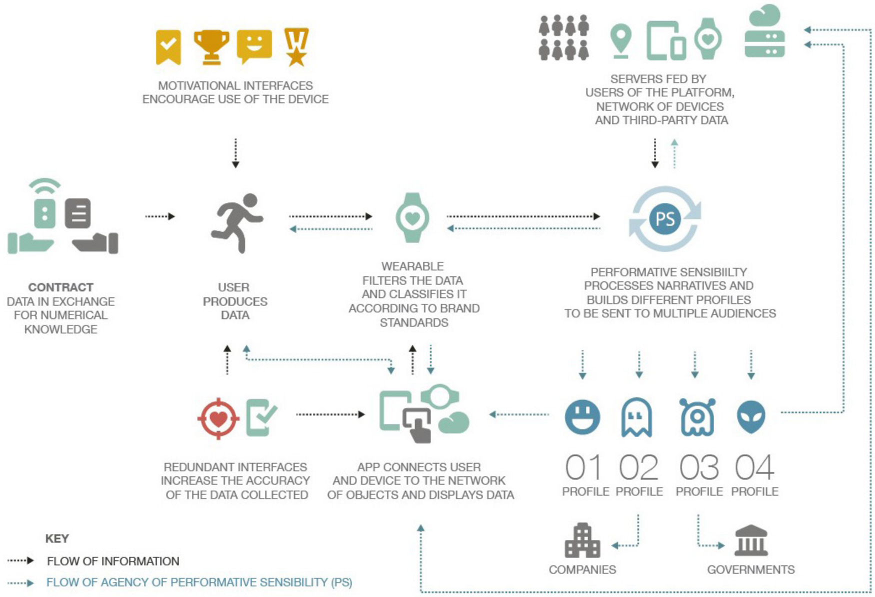

FIGURE 4 – Conceptual model of the agency of the performative sensibility in the production of procedural narratives

Source: Elias Bitencourt

It can also be inferred that the action of PS is distributed throughout the network and becomes more or less specific depending on the complexity of the actors involved. At the level of the user, the heart rate monitored by the device feeds the individual Cardio Fitness Level, while at the Fitbit level, each user's heart rate feeds a database that identifies collective patterns. In other words, we can say that for each user-Charge HR2 relation there is also a particular PS, just as there is a singular PS for each association that Fitbit establishes with individual users and corporate clients.

Finally, PS is an important mediator for the interoperability[15] of the Fitbit network. By collecting, processing, generating and forwarding information from different sources and materialities (electrical pulses, biometric data, body performances, texts etc.), PS manages messages, allowing objects and

[15]The idea of interoperability has an evident link with Latour's concept of interobjectivity (Latour, 2015). The French thinker argues that sociology has been constituted as a sociology without objects. He shows the weakness of social interaction (micro-dimension) or social structures (macro-dimension). Sociology avoids objects, criticizing them as fetishism or scientism. The idea of interoperability developed in this study implies Latour's interobjectivity, as an idea of action that treats objects as *social facts*.

people to communicate without needing a common code. This consolidates the argument that the performative and procedural model with which PS produces discourses could be a potential conceptual tool for developing an object-oriented approach (Nansen et. al., 2014, Mittew, 2014) to the communication of things.

COMMUNICATION OF THINGS

To acknowledge PS as the principle of the IoT is to highlight an aesthetics of materiality in which digitally-augmented objects sense, exchange information, learn and act in an extensive network. PS is a communicational "device" (Foucault, 1994) that translates the data performance into action through algorithmic strategies. It molds platforms and services to create a true communication ecosystem in symbolic, behavioral, corporal, cognitive, social and corporate layers, with greater emphasis on any particular aspect depending on the network in question (a smart wristband, a lamppost, a smart garbage can…). The symbolic layer deals with narratives and propositions; the behavioral with interfaces and performative interactivity; the corporal with actions based on digital biometric patterns; the social with strategies for engagement and sharing; and the corporate with institutional and business programs. All are present in the case analyzed in this article.

PS acts in a communicational process (the *Communication of Things*, or CoT) with its own particular characteristics that expand classic communication models centered on a transmitter and a human receiver (Figure 5). An understanding of the CoT is important to face the challenges posed by the IoT. The CoT model assumes that objects exert agency regardless of direct human action, expanding the possibilities for communication (including man-man and man-machine communication). We shall take a brief look at some of its main characteristics.

The language of the CoT is the code of machines, in which a machine is taken to be any information-processing device (Pticek et al., 2016). The language is procedural and performative and uses the code repertoires and processes in the computational systems environment. Commonly used codes are based on minimalist sensorial stimuli (such as tactile feedback, variations in vibration and pressure), visual stimuli (small codes that use variations in the colors and shades of LEDs), performative stimuli (a vocabulary of gestures and proximity detection), procedural stimuli (codes that use processes to communicate processes) and telematic stimuli (involving georeferencing technologies, biometrics and continuous connections).

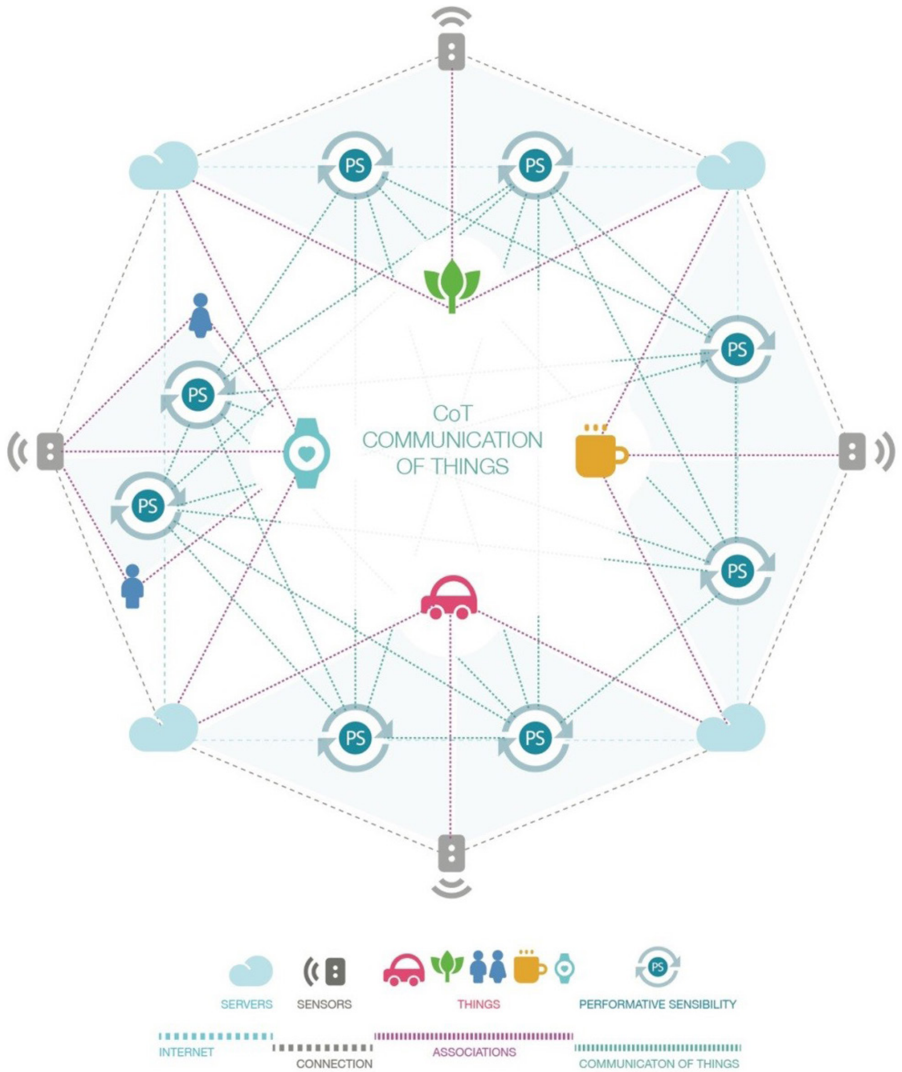

FIGURE 5 – Conceptual model of the communication of things and the communicational mediation of performative sensibility
Source: Elias Bitencourt

Unlike the intentionality underlying human communication, the CoT is autonomous. It does not depend exclusively on the intentionality of those involved, but it obeys action programs that gathers the actors, endowing them with sentient properties and computational awareness, such as PS, and reinforcing the idea of the computational autonomy of objects. Such as human communication, in which there is always uncertainty about what will be accessed

[16]For Deleuze and Guatarri (1995: 84), "just as there are asemiotic expressions, or expressions without signs, there are asemiological regimes of signs, asignifying signs, both on the strata and on the plane of consistency" (Ibid.: 84). In this sense, "assemblages are necessary for the unity of composition enveloped in a stratum, the relations between a given stratum and the others, and the relation between these strata and the plane of consistency to be organized rather than random" (Ibid.: 87).

and interpreted, communication of things also raises doubts. In the CoT, it is not possible to know what the transmitters, receivers, contexts, medium, code are because of the complexity of the multiple regimes of signs[16] (Deleuze; Guatarri, 1995) deployed during exchanges between sensors, actuators, systems, objects, people, companies, data, algorithms and heuristic processes. What separates the code from the medium, the transmitter from the channel or the receiver from the message is only the circumstantial condition of the associations established.

According to traditional schools of social communication, there must be a common code and a medium over which the communication can be transmitted. In the CoT there is, *a priori*, no common code or medium. Because of the complexity of the actors involved and the multiple particularities, different codes and media come into play. Sensors do not necessarily share the same repertoire of codes and media, nor a common grammar to communicate with a variety of bodies, objects and systems. The CoT is characterized by interoperability. Each time an association is established, the medium, code and message are negotiated over the network, protocols are translated and new ones are created. APIs and frequent firmware updates are some of the traces left by these disputes.

In the CoT, the code is an actor-network rather than an assumption or a language structure. There are multiple networks made up of multiple codes, just as there are multiple networks of code inside code. Hence, neither an audiovisual message that appears on the screen, nor the programming language, nor the algorithm, nor the data can be treated as pure entities. For each code negotiated when a message is being built by two things, there is always a multiplicity of codes producing new codes – self-generating algorithms (Krasnogor; Gustafson, 2002), for example – and negotiating associations (electrical pulses, binary code, different programming languages, categories, data frames etc.). The CoT is a permanent network-based transcoding process.

In the CoT, there are no defined roles for the various elements, as in the models proposed by Lasswell (1948), Shanon e Weaver (1963), for example, only *actors* (things). Hence, not only the medium, but the context and code can be transmitters, receivers and channels as well. A context, whether geographic or semantic, can send and collect data, and an algorithm can prepare a discourse, direct it to an audience, interpret messages received or appear as a "model receiver" for the communication established. Consequently, the CoT is symmetrical: everyone communicates with everyone, *everyone* is *things* and *things* are communicational actors.

The CoT is metacommunication, a product and a producer of new forms of communication. Driven by the contemporary media ecology, the falling price of sensors and the need to extract information from various everyday phenomena has led to an increase in the number of objects with PS. Endowed with informational and communicational properties, these objects function such as media by producing narratives, storing information, directing discourses and providing content all the time. They are material evidence of mediatization (Finnemann, 2014; Lundby, 2014). Unlike traditional mass media and post-mass media, they have other audiences. They communicate in the first instance with systems, companies, third-party software, data, other sensors etc. They, therefore, not only convey information but constantly produce new communication circuits.

CONCLUSION

This exploratory analysis of Charge HR2 revealed evidence of PS in the network of objects and people that compose the Fitbit platform. The PS of Charge HR2 suggests a change in the nature of objects in the IoT and that this new informational and communicational peculiarity, which is based on algorithmic performance and derived data, is felt throughout an extensive network. We argue that PS is a general characteristic of objects in the IoT, as it is a quality of the network associations rather than a technical attribute of the embedded sensors. Our analysis also confirms that PS changes the materiality of these objects, showing that data and connectivity are essential attributes of things in the digital age.

The findings indicate that the discourses promoting the attributes of Fitbit related to data extraction, continuous use of the device and connection to the network of associated objects frequently rely on the following arguments: (a) the activity tracker allows users to enhance their knowledge through personal statistics; (b) it motivates them to achieve goals; (c) it encourages them to better themselves and (d) it helps them to develop a more dynamic, healthier routine. Among the main interfaces required for the Charge HR2 technical features mentioned on the site there are procedural interfaces (algorithmic procedure-oriented autonomous communication), interfaces based on written language, network connection interfaces (Bluetooth and Wi-Fi), user graphical interfaces, and biometric interfaces.

Analysis of the corpus revealed that the network of connected objects (apps, wearables, servers, smartphones, smart balances etc.), the Fitbit brand content (patents, proprietary measurement units and brand categorization criteria) and the data captured directly from users are the main sources for building individual profiles and reports of customers' body performance. Scientific studies and worldwide standards (which were legitimized by international organizations such as the WHO) were the references that were least used to define individual health levels and guide routines.

The results show that PS is not only present in the computational object itself, but also spread throughout the whole network of the association in question. It acts as a fundamental mediator (actant) for interoperability between the different articulations of *humans and non-humans* in the sociotechnical Fitbit network, developing procedural narratives and managing their targeting at the many audiences that make up the data ecosystem. We showed how PS produces narratives from information sources derived from data circulated in the network of objects and parameters established by the companies that own the systems. The informational agency of PS suggests that media contracts should be reconfigured to consider the central role played by digital data and that the concept of the media ecosystem as we understand it should be expanded.

The analysis of the Fitbit system described here can be applied to any other IoT system. New, digitally-augmented social objects act through PS as important mediators in symbolic, behavioral, corporal, cognitive, social and corporate layers in various dimensions of contemporary digital culture (smart cities, wearables, smart homes, driverless cars etc.). A model of the CoT that can be used to analyze the social role of these objects is emerging. To recognize the communicational agency of objects and their role in the constitution of associations (and the social domain) is essential if they are to be included in a broad political discussion involving issues such as privacy, security, biopower, surveillance, the media and the global market. M

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