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Big Data and the Arts

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Abstract

Big Data has come and is here to stay pervading many human activities, including social, humanistic and natural sciences. This article briefly reviews the emergence of Big Data in Humanities and the Arts, as well as the opportunities and issues it opens.

1. Introduction

Big Data is a relatively recent term that has emerged as a widely recognized trend pervading many different human activities and attracting the attention from the industrial and commercial sectors, governments and academia (Hashem, Yaqoob, Anuar, Mokhtar, Gani & Khan, 2015). There is not a consensus definition for Big Data yet. Big Data is sometimes defined as "the amount of data just beyond technology's capability to store, manage, and process efficiently" (Manika et al., 2011). Very recently, Big Data has been similarly defined as "a term utilized to refer to the increase in the volume of data that are difficult to store, process, and analyze thorough traditional database technologies" (Hashem, Yaqoob, Anuar, Mokhtar, Gani & Khan, 2015). Introducing slight but interesting differential tinges, Magoulas & Lorica introduce the Big Data concept "when the size and performance requirements for data management become significant design and decision factors for implementing a data management and analysis system" (Magoulas & Lorica, 2011). Others define Big Data as characterized by the size of data volume, variety, and acquisition velocity, altogether usually mentioned as "the three Vs" (Zikopoulos, Parasuraman, Deutsch, Giles & Corrigan, 2012; Berman, 2013). Some authors add a fourth essential and key V to the features defining Big Data, namely, V for *value* (Gantz & Reinsel, 2011; Chen, Mao & Liu, 2014).

It should be stressed that Big Data is a relative and moveable concept in terms of data "size", taking into account both the actual historical moment and the human activity in which is going to be applied. It is clear that the amount of data to be considered "big" is not the same for the Information Technologies, Biology or History. And it is also clear that the maximal technological capability to manage data is continuously increasing. A recent analysis carried out by CISCO revealed that from 1992 to 2012 the amount of data transmitted across the Internet hugely increased from 100 gigabytes per day to 12 terabytes a second (mentioned in the AHRC *The Challenge of Big Data* brochure published in July 2014). Up to the beginning of the current millenium, most of the available information was maintained stored in analog storage systems (books, photographs, drawings, maps, discs, tapes, and so on). In 2002, digital storage of information amounted for a half of the global information sotrage capacity, thus marking the beginning of the digital age. In only five years, by 2007 almost 94% of the totality of the accumulated information was already digitally stored. Furthermore, the trend to accumulate new data is continuously accelerating so fast that currently more than 90% of

total data available in the world has been created in the last two years. Thus, currently the "size" of Big Data initiatives ranges from a few terabytes to many petabytes of data.

Although Big Data indeed refers to very large quantities of available data, now it seems clear that size is not the most relevant feature of Big Data, but rather the value of these data is what matters most. As mentioned in the presentation of the *Big Data and Big Challenges for Law and Legal Information* symposium held in 2013 to celebrate the 125 years of Georgetown University Law Library, this value of Big Data is related "with our ability to discover meaning by connecting points of information electronically, across numerous, vast, and often unrelated stores of data" (available in <http://www.georgetown.edu/library/about/125/symposium/index.cfm>). Therefore, the most relevant feature of Big Data is not its size, but its *relationality* to other data. And this is so because Big Data is essentially networked (Boyd & Crawford, 2011). In particular, Big Data coming from data tracking has introduced two new types of social networks, the so-called *articulated* and *behavioral* networks. In fact, networks are currently pervading all scientific, humanistic and social disciplines. For a review on networks and arts, see my essay on the issue recently published in *Rupkatha* (Medina, 2015).

This essay reviews the current and predicted future impact of Big Data in the study and practice of Arts. According to the online presentation of the *Big Data and the Arts* workshop that took place in Manchester last March-April 2014 within the *FutureEverything 2014* festival:

"Arts Organisations generate a lot of data in the form of web analytics, CRM systems, social media and digitised archives. Many believe that there is real value to the arts if this data is captured, stored, analysed and visualised. The aim of all of this is to gain insights (ideally meaningful and/or profitable ones) that would otherwise be unattainable" (available in futureeverything.org/events/big-data-arts-workshop).

This vision is close to that made public by the former president and current Chair-Emeritus of the *Leonardo Institute for Art, Science and Technology* Dr. Roger Malina in a keynote lecture given at ISEA 2012 (18th International Symposium on Electronic Art, Albuquerque, New Mexico, USA), as commented by Nicolas Triscott in his blog (Triscott, 2012):

"Malina argued that there is a critical role for artists in creating new systems of data representation, visualisation, sonification, and simulation, across fields ranging from astronomy, geology, nanoscience and medicine, to business and finance. (...). The key contribution that artists can make is in helping to create meaning and poetry from these vast data fields. "

In the Preface to the *MIT Digital Humanities* handbook (Burdick, A., Drucker, J., Lunenfeld, P., Presner, T., & Schnapp, J., 2012), the authors state:

"There remains a chorus of contemporary voices bewailing yet another "definitive" crisis in humanistic culture, yet another sacrifice of quality on the altar of "mere" quantity. Our response is not just a counterargument in favor of new convergences between quality and quantity, but also one in favor of a model of culture (...). Instead, we see this moment as marking a fundamental shift in the perception of the core creative activities of being human, in which the values and knowledge of the humanities are seen as crucial for shaping every domain of culture and society".

Although these words were written in relation with Digital Humanities, they can be completely assumed within the framework of the Big Data and the Arts issue.

2. Emergence of Big Data in Humanities and the Arts: Big Data is here to stay

According to the aforementioned MIT *Digital Humanities* handbook (Burdick, A., Drucker, J., Lunenfeld, P., Presner, T., & Schnapp, J., 2012), Digital Humanities were born as a natural consequence of the encounter between traditional humanities and the application of computational methods. The study of the historical development of Digital Humanities allows for the identification of five roughly chronological phases in this process (Baca & Helmreich, 2013): 1) Phase one would correspond to the recognition of the capacity of digitization as a procedure and Internet as a medium to greatly increase the accessibility and dissemination of information. 2) Phase two would be the first period of emergence and building of new computational and IT tools to be effectively applied in the digital humanities sphere. 3) Phase three would have focused the attention to the potential of new computational and IT technology for enhanced visualization and reconstructions and to create new virtual realities. 4) Phase four is identified with the emergence of open peer review, which is more debatable. 5) Finally, phase five would correspond to the last few years in which new modes of scholarly research have become enabled by the assistance of powerful computational analytic tools. It seems reasonable to connect phases three and five with the irruption of Big Data in the Humanities. In particular, the practice of the arts now includes new media and tools usage, as revealed by the expansion of electronic art, digital art, net-art and increasing applications and uses of big data in arts practice.

Taking into account the specificities of Big Data in the Humanities, it becomes clear that textual data, such as digital or digitized documents, letters, articles, press releases, and books are of paramount importance. Nonetheless, there are other types of important big data in the humanities, including sounds, cartographic data, fixed image data, moving images, 3-D reconstructions and virtual environments, games, social media, and -with an ever increasing importance- metadata such as GPS, mobile phone and Internet tracking of human activities.

In the last two years a seminal analysis of the relevance of Big Data in the Humanities has provoked a lively controversy due to its slanted economic viewpoint from its own title: *Counting What Counts: What Big Data Can Do for the Cultural Sector* (Lilley & Moore, 2013). Its claimed value of the notion of *cultural value*, as well as its claimed use of big data as a tool for cultural and regulatory policy based on the notion of cultural value, have opened severe criticism from those convinced that cultural value, if anything at all, is very different from the potential or the actual market value of culture. For instance, Boyd and Crawford alert against a new digital break or divide -based on the limited access to Big Data- between the Big Data rich and the Big Data poor (Boyd & Crawford, 2011).

In a note dated August 2nd, 2013 and posted in her Dean's Blog, Mary Anne Fitzpatrick, Dean of the University of South Carolina College of Arts and Sciences declared to have maintained a *quixotic* fight to "*avoid participating actively in data collection that allows companies to develop specific targeted marketing campaigns*"

(available in artsandsciences.sc.edu/big-data). In spite of this position against this primary, commercial use of big data, Dean Fitzpatrick stresses the importance of the challenges and opportunities presented by big data far beyond their use for commercial purposes. For her, the keypoint is that " *across all of the academic disciplines, the ability to handle, link and analyze massive amounts of data to answer important questions about the natural and social world is key element to our success*" and that the use of big data brings and opens new ethical and legal questions, as stressed by others (Boyd & Crawford, 2011; Pasquale, 2015; Landau, 2015). Certainly, as Dean Fitzpatrick concludes, big data is here to stay. Since the launch of the USA national "Big Data Initiative" announced by The White House in March 2012 offering more than \$200 million to support big data research projects, several other initiatives have been launched to promote big data research, such as the *Massachusetts Big Data Initiative*, the *European Big Data Public-Private Forum*, the *British Alan Turing Institute* and the *Canadian Open Data Experience*, among others.

The two major published Big Data projects within Digital Humanities are a *Quantitative Analysis of Culture Using Millions of Books* (Michel & Aiden, 2010) and *A Network Framework of Cultural History* (Schich et al., 2014). The former introduced the neologism *culturomics* that is currently understood as the use of the quantitative analysis of digitized texts to study cultural trends and human behavior. The use of global news media tone in time and space has been later introduced as *culturomics 2.0* to forecast larg-scale human behavior (Leetaru, 2011). The later is a scientific report that combines network science, sociology and art history to map the cultural history of Europe and North-America by reconstructing what the authors call "aggregate intellectual mobility" over two thousand years through the data of birth and death location for more than 150,000 notable individuals.

3. Big Data in Arts research and analysis. Opportunities and issues.

Along with funding to big data research of general interest, there are currently sources of funding for big data projects focused in the areas of arts and humanities. The *Arts and Humanities Research Council* (United Kingdom) is perhaps the recognized institution that most clearly has assumed Big Data as a priority, as stated in its web page on funding opportunities for big data projects:

"The AHRC recognises the potential opportunities for transformative research in the arts and humanities offered by developments in capacity to develop, exploit and re-use very large and complex datasets and to link together large and varied forms of data in increasingly sophisticated ways. It also recognises the distinctive and creative contributions that the arts and humanities can make to the development of approaches to the use of such 'big data', for example in terms of developing new types of visualisation and representation, exploring different contexts in which it might be used or inspiring creative ways to engage with data users." (Available in <http://www.ahrc.ac.uk/Funding-Opportunities/Research-funding/Themes/Digital-Transformations/Pages/Big-Data.aspx>).

This declaration identifies two main opportunities that the irruption of Big Data in the Arts and Humanities opens. On the one hand, the exploitation and re-use of complex datasets and the rewiring of data within and among datasets could help to identify problems and solutions we had not seen before. On the other hand, the recognition

that art researchers and artists could assume a critical role in the creation of new types of representation, visualisation, sonification, and simulation based in big sets of data. This fits well with the position of Roger Malina mentioned above, for whom this is a renewed way of connecting arts and sciences. Furthermore, Big Data opens up the opportunity to have access and use non-canonical material and new types of data, including moving images and sounds, in a more interactive fashion. This new and interactive use of this type of data could contribute to the emergence of new types of hypothesis and questions to be answered by further research, thus creating a positive feedback loop.

However, the irruption of Big Data in the Arts and Humanities also introduces new and great challenges and issues. Some of the main issues are identified in *Six Provocations for Big Data* (Boyd & Crawford, 2011), a paper presented at Oxford Internet Institute's "A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society" (21st September 2011): 1) A primary issue is the need to find out new ways of investigation breaking the traditional uses of the "old" humanities mainly based on the silent work of lone scholars and the leadership of the academy. The management and analysis of big sets of data depends on the development and use of computer tools for automatic operations of search, connection, representation and simulation leading to a needed change in the definition of knowledge itself. 2) The issues related with objectivity and accuracy. While the notion of objectivity has been central for the standard scientific methods, Big Data is still prone to subjectivity. Even worse, available large datasets are often unreliable, containing numerous uncurated, misleading and even false data. Thus, a non-critical use of raw data is dangerous and can lead to spectacular errors of interpretation and misleading conclusions. Therefore, it should be claimed an urgent search for new and more efficient and effective ways of curation for the immense sets of stored raw data. 3) In connection with the previous issue, it should be stressed that bigger data are not always better data. This is well exemplified by the case a *Twitter*, an extremely big source of data and -for this reason- a popular source for mining Big Data. Unfortunately, working with *Twitter* data leads to serious and complex methodological challenges that usually are not addressed by those who use them uncritically. On the other hand, the "spell" of Big Data can easily lead to despise the potential values of "small data". 4) A great problem with the current approach to the use of Big Data is the frequent but false assumption that data are interchangeable. In contrast, the meaning and value of data are extremely dependent on the context. Therefore, taken out of their context, data lose or change their meaning and value. The automatic processing, manipulation and analysis of Big Data very often takes them out of their context. 5) A big challenge is to solve the new ethical and legal issues introduced by the accessibility of Big Data. This is lively stressed in *The Black Box Society* (Pasquale, 2015), a very recently published book that studies the hidden impacts of personal data collection. Therefore, the efforts to protect privacy by controlling the use and misuse of data are gaining and should gain much more attention (Landau, 2015). 6) Finally, the mere development and growth of Big Data initiatives has already produced a growing gap between the poorest and richest, creating what Boyd & Crawford call "a new kind of digital divide".

4. Big Data in Arts practice

The opportunity and challenge represented by the creation of new types of representation, visualisation, sonification, and simulation based in Big Data has also been incorporated in some training and educational programs by the Academia. A fine example of this is the Royal College of Art's Master's program in *Information Experience Design*, which explores new and different ways of using big sets of data in Arts practice and design.

There is also open wide space for the participation of professionals other than artists, as well illustrated by one of the most famous and mentioned works in the field of big data visualisation: *Wind Map* (available at hint.fm/wind), showing the delicate tracery of wind flow over the USA. The coauthors are the computational designer Fernanda Viégas and the mathematician and journalist Martin Wattenerg, appointed as co-directors of Google's *Big Picture* visualisation research group. *Wind Map* is constantly updated (in fact, every hour) using surface wind data coming from the National Digital Forecast Database. Its aesthetic and "artistic" values were publicly recognized when it was shown and exhibited at MoMA.

Many artists formerly involved in more "primitive" and simple practice of electronic and net-art are currently migrating to the use of sources of massive data to explore the challenge of creating new types of representation, visualisation, sonification, and simulation based in Big Data. Many representative artworks and performances are exhibited in events such as the annual International Symposia on Electronic Art (the last three editions -2012 to 2014- took place in Albuquerque, Sydney and Abu Dhabi and the next one is announced that will take place in Vancouver between August 14th and 18th, 2015). Some of these experiences are presented, commented and analysed in *Leonardo* (the journal published by the International Society for Arts, Science and Technology), as well as in the annual Leonardo Day at the Network Science (NETSCI) Conferences (as the Copenhagen 2013, the Berkeley 2014 and the announced Zaragoza 2015 NETSCI conferences).

The list of artists and creators involved in Arts practice related with the use of Big Data is very extensive and is constantly growing. Here only a few iconic, representative examples of artworks and projects using Big Data will be provided. Perhaps one of the most famous installations based in Big Data is *Listening Post* (2001-6), by Mark Hansen (a statistician) and Ben Rubin (an artist and designer). Exhibited for the first time at the Brooklyn Academy of Music in 2001, and afterwards at the Whitney Museum (New York, 2002) among others, the authors commented and discussed its conception and making with Luccy Bullivant in an academic article published in the journal *Architectural Design* (Bullivant, 2005). In the Winter 2013-4 issue of the online journal of new media and culture *NmediaC*, Wes Modes (from the University of California at Santa Cruz) made a deep and complete description and analysis of this highly influential and "aureal" installation, including comments on data sources, gathering and processing, the sonification, visual display, presentation structure, the systems and software (Modes, 2014). In *Most Blue Skies I+II* (2006-2010), Lisa Autogena and Joshua Portway created a computer-generated installation aimed to find "the bluest skies" in the world. To achieve this goal, the passage of light through particulate matter in the atmosphere for five million locations on earth is measured and the exact colours of the sky at each of these

locations is calculated, allowing for real-time reproduction of the colour of the bluest sky every minute. *Data Sea* (2009) was commissioned to Michael Takeo Magruder for the International Year of Astronomy 2009 and is introduced as a networked, real-time 3D installation that is a virtual environment exploring the relationship between broadcast media and astronomy. *The Obelisk* (2012) is a minimalist kinetic sculpture made with acrylic, wood, paint, polymer, a microcontroller and instances of crimes against peace found online. Symbolising a metaphorical exploration, the artwork can change one of its pieces from opaque to transparent according to the number of instances (found in real-time scanning online of news websites) referring to the four main crimes against peace (crimes of war, crimes of aggression, crimes against humanity and genocide), as they were classified during the Nuremberg trials. Eric Fischer has made use of data from geotagged photos to create several series of projects, such as *Locals and Tourists* and *Geotaggers World Atlas*. In the former, Fischer makes use of tagged photos from Flickr and Picasa to analyse where natives and tourists take pictures, thus providing an interesting perspective on how differently a city is perceived by its inhabitants as compared with its visitors. In the later, cities are ranked according to the number of photos taken in their midtowns.

Eric Fischer along with other creators such as Timo Arnall, Christopher Baker, David Bowen, Ingo Gunther, Chris Jordan, Erik Kessels, Aaron Koblin and Near Future Laboratory, among others, take part in the project *Big Bang Data*, a co-production of *Fundación Telefónica* (Madrid, Spain) and CCCB (Centre de Cultura Contemporània de Barcelona, Spain). *Big Bang Data* explores the phenomenon of data explosion we are currently experiencing. The exhibition was firstly presented at the CCCB (9th May-16th November 2014) and will be shown at *Fundación Telefónica* (12th March-24th May 2015).

Fundación Telefónica funds the *VIDA Art and Artificial Life International Awards* since their launching in 1999 to support artistic investigation into artificial life and to promote production in this field. The most recent edition of these awards, *VIDA 16.0* has awarded the first prize to the project *Computers Watching Movies* by the Chicago-based artist Benjamin Grosser.

5. Big Data for Arts History studies

Digital Humanities as applied in the field of Arts History becomes *Digital Art History*. This topic is commented by Johanna Drucker in her essay *Doing Art History Digitally/Doing Digital Art History?* (Drucker, 2013). Drucker was one of the co-authors of the MIT *Digital Humanities* handbook and the keynote speaker of the *Digital Art History- Challenges, Tools & Practical Solutions Workshop* held in Málaga (Spain) from 20th to 22nd September 2011 under the scientific direction of Nuria Rodríguez Ortega and Murtha Baca. *Visual Resources: An International Journal of Documentation* dedicated the whole issue 1-2 of volume 29 (2013) to the topic Digital Art History.

Within the framework of the *International Conference Digital Art History: Challenges and Prospects* that took place in Zurich past June 2014, the *Zurich Declaration on Digital Art History* was drawn up. This Declaration devotes one of its eight points to Big Data in the following terms:

" Big data is expanding the horizons for art history research. This calls for appropriate IT infrastructure, scientific networks and funding instruments so that research can tap into the potential of growing databases. At the same time, research data and collection data from archives and collections need to broaden their reach". (Available in: <http://www.gta.arch.ethz.ch/events/digital-art-history-challenges-and-prospects/download>).

Several Digital Arts History studies making use of Big Data have already been done and many more are expected for the immediate future. This is the case of *Explicit Art Historical Image Referencing on a Big Scale* (Warnke, 2012) and the Royal Holloway University of London project on *A Big Data History of Music* funded by the AHRC Big Data Research Program.

6. Concluding remarks

Currently, Big Data pervades many human activities, including industrial, economic and political decision making, but also scientific, sociological, cultural and artistic reflection, research and practice. It is expected that the explosion of Big Data will contribute to a radical transformation of Arts and Art history research, analysis and practice.

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