IT'S NOT WHAT YOU LOOK AT THAT MATTERS, IT'S WHAT YOU SEE:

ANALYSING THE CONTEMPORARY PARADIGM SHIFT IN NARRATIVE INFORMATION DESIGN

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DECLARATION

I declare that the work described in this research Paper is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

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SUMMARY

Information design is currently in the process of a significant paradigm shift; off the pages of newspapers and books, onto the digital screens of the countless internet users in our modern, information society. Enabled by changing societal trends and rapidly increasing computational power and accessibility; information design is no longer a limited, static or exclusive academic tool. Rather, it is becoming a boundless, dynamic, awareness raising mass medium.

This paper takes a critical look at this evolution of information design with particular focus on the narrative capabilities and competencies of its implementation. Analysing the field both critically and historically, an understanding of the basic principles of information design are established, allowing significant insight into the place information design now holds in the digital, data laden age.

Using current, public facing examples of information design as benchmark, this paper evaluates the narrative elements of successful, interactive information visualisations, providing a stepping stone towards a set of standard principals for the present domain.

Finally, an in-depth review of one outstanding practitioner, Hans Rosling, is presented as a pioneer of a number of avant-garde visualisation techniques and a driving force of the fields' future. A firm believer in information designs' ability to tell stories and allow users to "see" the statistics at hand; Rosling, his colleagues and their successors are responsible for the popularisation of information design. A trend which has allowed the practice to come to the fore of public and academic interest, and which shows no signs of slowing momentum; the popularisation and the intrinsically linked demand for narrative information design served as both the inspiration and justification for this paper.

TABLE OF CONTENTS

TABLE OF FIGURES

CHAPTER I

INTRODUCTION

Predating writing, storytelling has forever been one of the human race's primary and most accessible means of information exchange. Used to convey experiences and cultural values, to educate, entertain and inform, the traditional narrative is a tool of immense power when utilised in an effective manner. Beginning as simple oral verses, the passage of time has seen the traditional narrative branch off in a multitude of directions such as the print novel, film and journalism. In the current, digitally driven information age, information design and information visualisation have emerged as a popular, capable and compelling medium of information exchange and communication, with distinct and definite narrative capabilities.

This paper intends to work towards a distinct understanding of information visualisation as a narrative tool and also analyse the on-going paradigm shift within the wider field of information design. In order to establish an understanding of the correlation and dependence of this change with regards to technological and societal development as a whole, the argument will address these issues both critically and historically. With reference to current influential material complementing explicit analysis of significant historical practitioners and their works, this paper will endeavour to establish a contemporary appreciation for information design and its narrative competencies, forming a stepping stone towards the development of a set of unambiguous principles for the field of narrative information design.

It is important to qualify that the terms "information" and "data" under discussion in this paper refer almost explicitly to numeric and statistical data. When visualised, the graphical representation of this data is, by nature, quantifiable and inextricably linked to the data. The human vision system is capable of processing massive amounts of visual data with ease and speed. Therefore, information visualisation emerges as an obvious and profoundly appropriate tool to aid the understanding of complex subjects.

Using history as a guide, the common principles of accomplished information visualisation can be ascertained. The first presentational graphics were published in 1786 by

William Playfair. Since then, the practice of information visualisation has gone through varying degrees of development, innovation and refinement to reach its current societal standing. From the works of Florence Nightingale through the inspiring and oft-commemorated graphics of Joseph Minard, a pronounced tradition of telling stories through the use of visuals established itself in the work of literary figures, statisticians and scientists alike.

The advent of the information age has allowed these information visualisations to shift from the pages of books and newspapers onto our digital screens in the form of dynamic, explorable applications. This migration, and the technological and social developments that are intrinsically linked with it, have had wide ranging consequences for the field of information design and the exploitation of its narrative competencies. Of these effects, the most obvious and pertinent to this paper is the rapid and seemingly endless expansion of the scope of information design and visualisation. Free from the restraints of pen and paper, and empowered and enabled by the previously inconceivable processing power of ubiquitous modern computing, massively complex datasets can now be presented in an easily comprehensible manner by information design.

Through the methodological utilisation of established information design practices, the designers in this field are in a unique position to create information visualisation installations which highlight the seemingly important features of data, ranging from correlations across multiple dimensions (e.g. time) to supposed patterns within the data. Revealed through intricate exploratory analysis of the end product, it is commonly held that without visualisation, these relationships and correlations would not be apparent even to expert analysts let alone the average user, due to the vastness of the original dataset.

In Chapter 3, an in depth analysis of the state of the art, with regards to the fundamental historical, academic and literary contributions, shows how information design has advanced from its humble beginnings, journeying through various periods of flux, to an eventual position as a burgeoning, popular mass medium.

This paper proposes that the clear expansion, adaption and acceptance of information design as a competent narrative tool, is intrinsically and elementarily linked to the development of modern technologies and the human race's overwhelming reception to the ubiquity and abundance of technology, information and data associated with the information age. In Chapter 4 this proposition is elaborated on, delivering an allegorical account of the exponential increase in the collection and manipulation of information, forcing

the global population to adopt new relationships with the data they encounter on a daily basis. Essential to this discussion is an understanding of how the human mind perceives and cognises information and how, although our mental capacity is finite and bound by evolution, the advances made in the information age have allowed us to take pronounced advantage of externalised cognition, increasing our ability to comprehend data which is understandable but until now was presented in a cumbersome and unsuitable format. Combined with the exposition of interactivity as a fundamental means of data display, interactive information visualisation can now result in the production of graphics that are aesthetically pleasing, effective in narrating information to the user all the while remaining accurate to the information it represents.

Chapter 5 explores the narrative qualities of information design; its similarities to other, more traditional narrative formats, and the new methods of storytelling that have come about through the increased application of information visualisation. These procedures and techniques are in their infancy and it is only through continued use and analysis that a full understanding of their operation and limitations can be reached. However, due to the manner in which this field has developed, there is a distinct issue concerning the absence of a widespread field of professionals, designated and dedicated to the advancement of the practice of information design.

As a result of this fragmented domain, it is often difficult for those tasked with visual information design to extract the relevant, meaningful information from a given data set. While the fields of statistics, data mining, graphic design and information visualisation are all closely linked in abstraction, the real-world individuals working in these fields are often unskilled in and even unaware of the abilities of their assumed counterparts (Fry, 2004). In order to allow information design to establish itself as a unique profession and hence allow the evident progressions to continue, the academic focus must move away from the viewpoints of the individual field of study specific instances have emerged from, and instead focus on the practice of information design as a self-contained discipline.

This quandary; however, is neither definitive nor omnipresent. There are a number of distinct, high profile individuals who have recognised the extraordinary narrative ability of information design and are utilising this to its maximum potential. In chapter 6, the work of Hans Rosling is discussed in light of his overwhelmingly successful storytelling information visualisations at the celebrated and prominent "Technology, Entertainment, and Design" conferences (2013). While not alone in this field, Rosling is exemplary of the results achievable through information design when proper practice in both narrative

structure and visualisation design are observed. Championed by this paper as a pioneer of modern visualisation narratives, Rosling has managed to capture the public's imagination with his engaging, moving and thoroughly entertaining visualisations concerning world health and international development.

With comprehensive popular interest now trained on information visualisation and its narrative traits, this paper intends to achieve with words what visualisation accomplishes with figures and numbers; to explain and analyse the current state of information design in the context of its contributing and developmental factors, in a palatable and discernible manner. Hans Rosling has said of his visualisations "let my dataset change your mindset" (TED, 2013); applying that same rationale to this paper allows a succinct understanding of the argument at hand to emerge. It is only through and with a comprehensive interpretation of the field that we can expect to contribute and progress upon the techniques and methods apparent today. In closing the argument, a number of suggestions are made about how this can be best and most effectively achieved, to ensure the continued utilisation and advancement of the field as a tool for mass assisted understanding.

CHAPTER 2

METHODOLOGY

This paper aims to discuss the manner in which information design and visualisation can act as a powerful and engaging storytelling device, representing allegorical and statistical facts in an attractive and digestible form. The research contends that; enabled by modern cultural and societal trends, combined with the technological developments of the early 21st century, information design has evolved from its basic roots of ink and paper to become a flourishing and populated field of dynamic, interactive and aesthetically charged multimedia applications. As practitioners increase the effort with which they push information design and its narrative qualities as an apt medium, this examination intends to argue that public interest and attention for the multi-skilled craft can also be seen to grow almost exponentially and in line with this course. While establishing and investigating these linked causalities, the critical analysis in this paper will focus on the fundamental intricacies of each of these individual topics and attempt to show that each one is intrinsically linked to the recent, obvious, progressions in the area of information design.

The inspiration for the discussion in this paper transpired as a result of an observable increase in the utilisation of information visualisation in both popular and academic media; and a disconcerting lack of significant, seminal literature on the present domain. In light of the scarcity of strictly relevant literature, this paper will examine the most relevant critical writings on the themes of information design, statistical analysis, human perception and the information age and data culture. While not immediately relevant to the argument at hand, in order to form a richer sensitivity to the underlying foundations of information design and the already evident tendency towards change within the practice, a chronological and analytical overview of the key persons, movements and developments in the area of information design is communicated in Chapter 3. This allows an informed interpretation of the contemporary field and the factors which led to its advancement and current standing.

The abstractions gained from this review of relevant literature are applied to the argument of this paper as a whole and are used to inform and guide the hypotheses developed within the paper regarding the narrative qualities of information design and the

changing nature of data. Not wanting to foster unqualified presumptions, peer reviewed journal articles and cutting edge media outlets which bear a closer affinity to the prevailing state of the art are considered in discerning detail and are utilised to promulgate the positions and understandings of the arguments central to this discussion.

Finally, in order to intimately recognise and comprehend the true capacity and competency of modern dynamic information design as a statistical and illustrative narrative device, this paper will employ the works of Hans Rosling and the Gapminder foundation (2005, 2008) as an example of pioneering and exemplary narrative based information visualisation which is utilised in an effective and contextually relevant forum.

Due to the scope of this paper and the limitations of the surrounding academic field, only recognised and peer reviewed qualitative sources were considered for review and research in the construction of this argument. While there is slight reference to quantitative properties in the discussion of the popularisation of information design, due to the perpetually fluctuating nature of internet view statistics the figures mentioned are intended for reference and conceptual purposes only and are not to be consumed as absolute. Although an over-reliance on qualitative information and analysis is not ideal for any paper, it does not hinder the accuracy of the ideas developed within this paper as the manner of discussion is essentially theoretical and is not reliant on the establishment of conclusive findings.

Through the application of this methodology and qualitative analysis framework, there is a clear discussion of the contemporary field of information visualisation and its increasing use as a forward facing, public, narrative device. The current state of the art has seen numerous contributions and developments which prove vital to the relevance of this discussion and its propositions. In concluding the arguments, a number of natural and significant implications and indications for the future of the practice are revealed and are pondered as such.

CHAPTER 3

STATE OF THE ART

Information visualisation is at a stage of development where it finds itself making a fundamental transition from a largely academic, statistical, and scientific background to a variety of more mainstream implementations with mainstream users.

As a standalone profession, information visualisation has only been recognised as a field worthy of its own title by the academic community since the mid-1980s (Fry, 2004). Hence, as a youthful but perpetually growing field of study, the seminal texts on the specific topic of contemporary information visualisation itself are comparatively few in relation to other, more established design disciplines. This is not, however, a burden on the expansion of the field as those interested in furthering the available research on information visualisation have a vast library of significant works in the practices of statistics and graphic design to peruse, supplement and reapply to the area.

Researching the domain of information design as means for communicating factual and allegorical narratives, it becomes apparent that the field is established on a foundation of work from various differing, but hypothetically linked, professions. In order to survey the current state of research on information visualisation and its potency as a narrative tool, peer-reviewed literature from the disciplines of graphic design, statistics, communication, and computer science have been analysed. Interestingly, upon close inspection, the literature in question begins to read akin to a chronological, historical narrative in itself; from in depth summaries of the origins of information design and visualisation (Funkhouser, 1937) through to the avant-garde popularisers of entertaining, aesthetically beautiful information visualisations.

Origins

An in depth discussion of the sequential evolution of early information design, through its ancillary fields, is beyond the scope of this dissertation. A critical view, however,

of the dominant contributors and their contributions to the development of the practice, is necessary in order to beneficently comprehend the current state of the art.

Long before technology allowed digital, on-screen visualisations, information design began as illustrated charts and graphs. Unlike many other professions, the founding figures of information design are well documented in both the archived original publications discussed below and more recent surveys of the early work in the field such as the pragmatic ordered list of inventions and developments in the field provided by Michael Friendly and Daniel J. Denis (2001).

The undeniable father of statistical graphics; and by virtue of this, an instigator of modern information design, is William Playfair. Playfair, a political economist, is credited with inventing the bar chart and the pie chart, while also popularising and improving upon a large number of commonly used visualisation tools and practices through his use of "linear arithmetic" (Tufte, 2001, p. 9). He believed that graphically visualising information was a far more effective means of aiding understanding than the practice of scrutinizing extensive tabular data, which was the norm mode of analysis in his profession at the time.

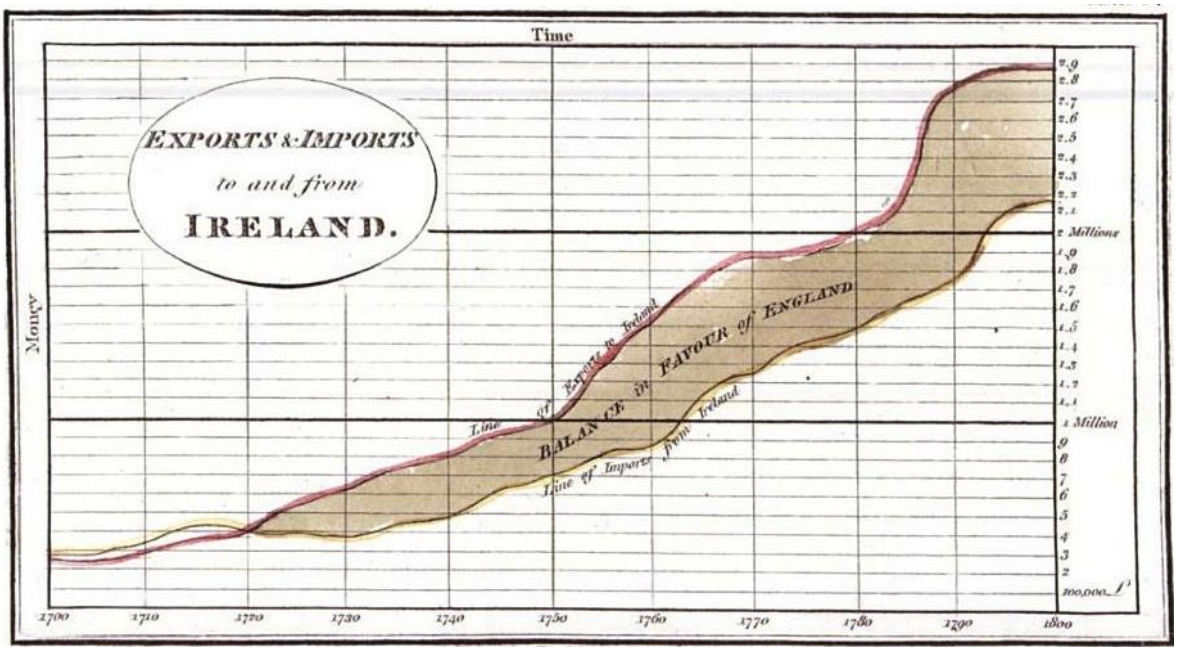

Figure 1. Example of William Playfair's early time series graphs.

> *On inspecting any one of these charts attentively, a sufficiently distinct impression will be made, to remain unimpaired for a considerable time, and the idea which does remain will be simple and complete.*
> (Playfair, 1786, p. 4)

It was his belief that a visual representation of statistical data allowed readers to gain an instant, contextualised and succinct insight into the data. This understanding, which otherwise may have been misconstrued or overlooked entirely, was the driving force behind the inception and production of his revolutionary text The Commercial and Political Atlas (1786) in which an overwhelming majority of these developments took place. It is difficult to find a text on information design that fails to mention Playfair and his works; this alone emphasizes the extent to which his influence is, and was, crucial to the advancement of the practice.

Following in Playfairs' footsteps, a number of scholars began to demonstrate early examples of the potential that information design possesses to narrate complex information effectively to a wide, public audience. This period, which spans the years 1850 – 1900 has come to be known amongst the information design community as "The Golden Age of Statistical Graphics" and the reasons for this are described in great detail in Michael Friendly's A Brief History of Data Visualisation (2006).

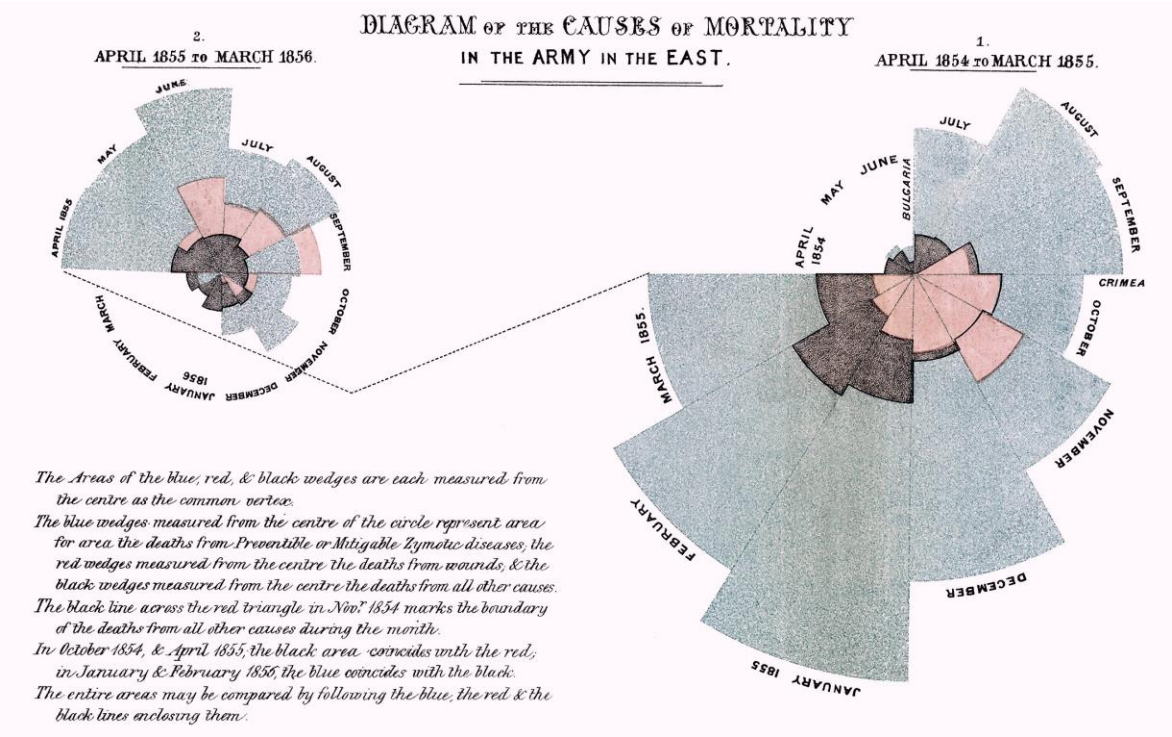

Figure 2. Florence Nightingale's original Rose Diagram.

Another focal point in this literary history of informational graphics concentrates on the work of Florence Nightingale. While some audiences might identify Nightingale as the founder of modern nursing, she was also a cutting edge statistician of her time. Nightingale made exceptional use of Playfairs' pie chart in her eight hundred page expose, which she

presented to the Prime Minister of Great Britain, Lord Palmerston, in 1857. Focussing on highlighting the number of preventable deaths in the preceding Crimean War, Nightingale has since then been credited as a pioneer of information design as a tool in public policy documents. Interestingly, one specific pie chart within this document became so influential in itself that it earned its own title, the "Nightingale Rose Diagram' (Cohen, 1984).

In 1869, not long after Nightingales' contributions, Charles Joseph Minard put pen to paper and produced an information narrative graphic which, while accurately and effectively plotting six intricate and multifarious variables (army size, location, direction of army's movement in two dimensions, temperature and dates) also retells the harrowing story of Napoleon's army and their eventual catastrophic fate in Moscow . This graphic, which appears as the final page of a lifelong portfolio of excellent information design subjects (Robinson, 1967), has been upheld as "the best statistical graphic ever drawn" (Tufte, 2001, p. 40).

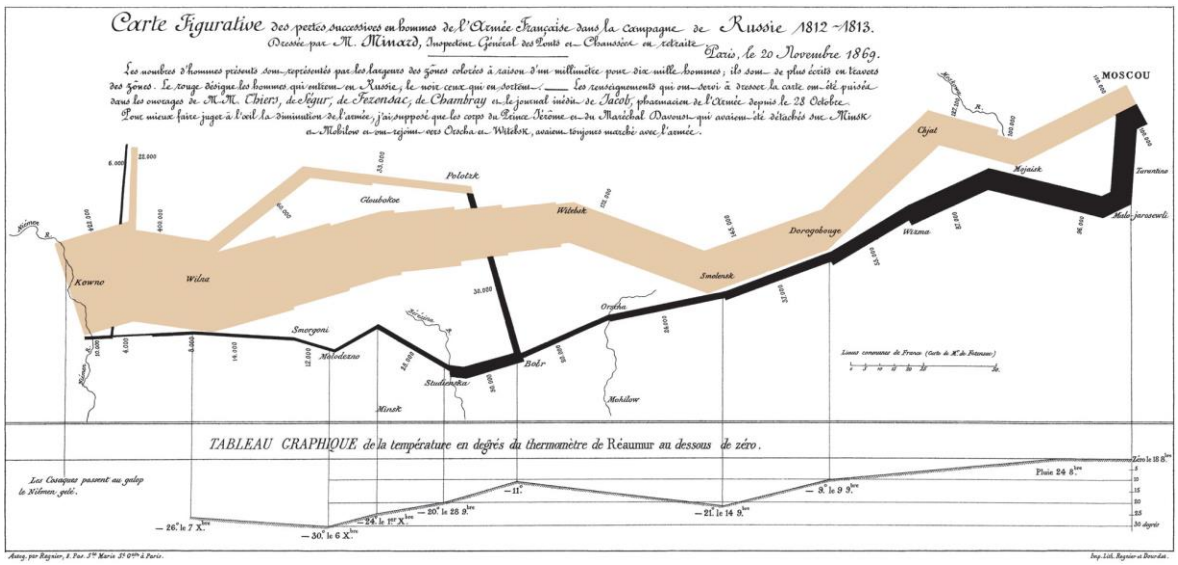

Figure 3. Charles Joseph Minard's graphic visualising Napoleon's 1812 Russian campaign.

These documented examples of information design and visualisation are clear indicators of the ability that well designed information has to narrate elaborate datasets in a manner which is approachable by not only expert viewers, but the average interested layperson. The literature covering this period is valuable as it grants us an insight into the existence of a long standing awareness surrounding the ample communicative powers of information design. Similarly, as the literature is predominantly concerned with the

progressive development of the discipline, analysing the origins of information design provides us with a strong theoretical understanding of the practice.

Re-birth and Rapid Development

Following the golden age; contrary to the apparent progressive trend in information visualisation was a period of roughly fifty years where progress, activity and direction within the field experienced a fundamental shift. This "Dark Age" of visualisation, was categorised by a move towards exact, formal quantification of statistics and a view that graphic visualisations were "just pictures" (Friendly and Denis, 2001).

However, the potential value of information design is not when it is solely being used within an expert community. It's true worth, as suggested by Michael Danziger in his thorough analysis of information design as a public facing mass medium, begins to become apparent in its mainstream utilisation as an expressive, public facing, communicative device (2008).

This principle was recognised by the Austrian sociologist, Otto Neurath, one of the few shining lights of this dark age of information visualisation. Neurath was attracted to the use of visuals in history as far back as the ancient Egyptians' use of hieroglyphics. This led him to the idea that a visual language could become an international supplementary language to spoken language. He himself proposed that "visualisation could humanize and democratize the world of knowledge and intellectual activity" (Neurath, 1937).

Following this train of thought, Neurath invented the compelling and universally recognised system of icons named Isotype. This language, while not necessarily universal in its original form, inspired designers throughout the world in their creation of informational identifiers of location, service directions and transport and warning signs, and most notably restrooms.

While Danziger's treatment of information visualisation as a mass linguistic device is largely allegorical, it is a fascinating insight into the range of uses of information visualisation possible. More captivating, however, is through assessing literature from outside the standard information design field, an observation is revealed to us. Regardless of the context of use, information visualisation is always, at some root level, concerned with narrating information from the designer's viewpoint to the user's understanding and best

practice dictates that information design is most effective when the visualisation is directed at a general public of both expert and non-expert viewers.

With this in mind, the dawdling period of growth in contributions to information visualisation was, not surprisingly, short-lived. Due to the dawning of the information and digital age, what followed was a period of unprecedented development in virtually all areas of design, computer science and communication and information design was no exception to this rule.

John Tukey's momentous The Future of Data Analysis (1962), put information design back on the map as a legitimate form of statistical investigation. Spurred on by refreshed academic and literary coverage and twinned with a rapidly changing landscape of technological advancements in computer processing power and resolutionary capabilities of display equipment, designers gradually began to regain interest in information design, tempted by the prospects of eventually building complex, precise and impressive information graphics via computer programs.

It is this period and the developments which followed that this dissertation is primarily concerned with. The literature surrounding information design written after 1950 begins to move away from recounting the geneses of the field's principles. A highly enthusiastic, confident and almost universal tone, peddling the significance and necessity for information visualisation as a public medium, to guide users through the ever increasing information overload of the digital age, begins to emerge. The ubiquity of this sentiment has even been recognised within the literature, and is known by those involved as "the standard rationale of our field" (Van Wijk, 2005, p. 79).

Modern Pioneers

> *Graphical excellence consists of complex ideas communicated with clarity, precision, and efficiency.*
> (Tufte, 2001, p. 51)

If Playfair was the torchbearer for information design in the 18th century, and Nightingale and Minard the drivers of information through the turbulent 19th century, the undeniable contemporary authority on all forms of information visualisation, information

design, data visualisation and graphical design excellence in the 20th century is Edward Tufte.

Tufte came to prominence as a figure of esteem within information design as a result of his treatment of the relationship between visual design and the comprehension of data with an emphasis on the story telling aspects of interactions of this type. Concentrating on promoting intelligibility, straightforwardness and aesthetics, Tufte is famous for penning concepts such as "data-to-ink ratio", "chartjunk", "lie-factor" and "small multiples". These concepts, which span a career of visual studies, are presented in his books Visual Explanations (1997), The Visual Display of Quantitative Information (2001) and Beautiful Evidence (2006).

Labelled as an aesthetician by those who critically analyse his literature (Horn, 1999), Tufte consistently maintains that the driver behind information visualisation and his works, and the repeated emphasis of the need for proper design practices within the field, is not simply to enforce aesthetic design principles in an attempt make data appear pleasing or impressive. He does, however, acknowledge that when proper practices are considered, the result is often exciting and visually pleasing, with an ability to entice viewers with no prior interest to the subject matter dealt with by the visualisation.

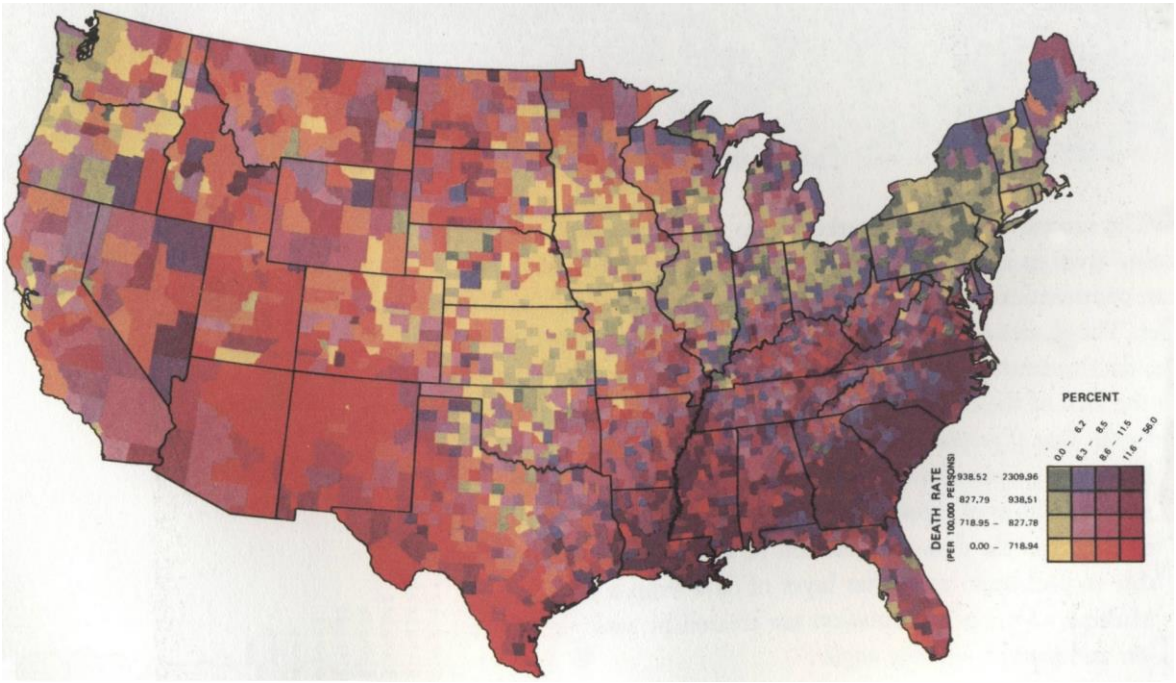

Figure 4. While a visually appealing, multi-functioning graphic; Tufte (2001) argues that the use of sixteen colours transforms this image into a crypto-graphical puzzle.

Tufte, however, often takes this emphasis on simplicity and accuracy to extremes, promoting the removal of any "content free" elements of a graphic which do not act as representations of the dataset in question (2001, p. 177). According to his work, the style of the image should never overpower the substance, because the information's inherent style, and the story-telling aspects of any time-narrative series, will become apparent through a true representation of the data.

While Tufte's works are an invaluable resource with regards to the principles of visual design, they are no longer considered as the bible like reference of information design doctrines and codes they once were. The influence of Tufte's work has in no way diminished, but the information design community has seen even further exponential progression since his time and has left his works ultimately, out-dated. This comes down to the simple fact that at the time of publishing, the creation of data visualisations seldom required consideration to be paid to what now seem fundamental aspects of their design, such as continuously changing data, massively complicated and expansive datasets, or user oriented interactive processes.

In saying this, it must be stated that this "out-datedness" is not a phenomenon unique to Tufte's work. While there is a rich tapestry of academic literature available to those interested and involved in information visualisation, the bulk of the texts are analytical only in hindsight, and are directed exclusively towards those immersed in the specific field of the works' origin. As with Tufte, this does not in any way discount them as valuable referential resources; it simply requires a degree of acknowledgement that the literature was written at a time before the widespread social adoption of advanced technologies and thus leaves the discussion lacking on a number of talking points essential to the premises of information visualisation in this dissertation.

The most obvious of these omissions are direct consequences of the technology available to the scholars at the time of their publishing. Particularly pertinent to this dissertation are the lack of discussion on situations in which the visualised information is fed from a live data stream or continuous source. Information visualisation is increasingly being utilised as not only an expert communicative tool, but as a public facing information narrative device. Aided by designers' abilities to visualise incessantly updating datasets with relative ease, viewers can now be guided along a narrative centred on the changing nature of the data. Additional to this, ever increasing computational power has allowed information designers to set their sights on visualising vast and complex bodies of variables that until very recently, were simply implausible (Fry, 2004). Finally, as a means to

navigate these new, vast and dynamic visualisations, interactive functionality has materialised as the most effective, affective and intuitive solution and little reference to this collaboration is made in the pre-21st century literature.

Dynamic Information Visualisation

The Information Age's continuous development is responsible for, and represents a crucial shift in the way modern society relates to and views informational data. Ubiquitous digital technologies have radically increased the means and methods of data exchange and consumption and there are no immediate signs of this trend changing. There is a growing trend in the literature surrounding information design, calling for an updated look at the theories and principles that information visualisation and design draw from; to keep in line with the transitions the practice has already seen, to scale the current visual representational methods to operate within the already expanded and still expanding technological parameters and to finally take full advantage of the long known potential information design has as a public mass medium of information transfer.

This inclination towards promoting the edification of the discipline is notably evident in the work of American political scientist, Robert E. Horn. In his works Horn developed a number of concepts which have contributed greatly to the development of information communication and presentation such as "information mapping" and "structured writing. Two of his publications in particular, however, Visual Language: A Global Language for the 21st Century (1998) and Information Design: Emergence of a New Profession (1999) deal specifically with the topic of information design.

In these works Horn proposes an updated definition for information design which includes a number of objectives, one of which is "To design interactions with equipment that are easy, natural, and as pleasant as possible". He then develops this characterisation to qualify information design's position within the wider field of design, stating that the distinguishing factors of information design are efficiency, effectiveness and information communication. He proposes the need for information design as an integrated profession, to reduce the ambiguity surrounding the field which is a result of the currently discorded nature of the composition of the discipline. Finally he identifies the major tensions in the profession and suggests methods for the "democratization" of information design to ensure its long term viability as a solver of human communication challenges.

While Horn's writing does not deal with the narrative nature of information design explicitly, his work is a marked introduction to the modern state of the art, providing us a balanced and rational view of its current standing and an updated interpretation of the potential and limits of information design in a ubiquitous information age.

Benjamin Fry, an American expert in data visualisation and co-developer of the programming language Processing (Reas and Fry, 2007), reiterates the rhetoric expressed in Horn's work for the necessity to integrate the various contributing professions and for the establishment of a standalone vocation.

In his Ph.D. thesis "Computational Information Design" (2004) Fry proposes that while computational abilities with regards to the capture, processing and analysis of information are perpetually increasing, our human capacity to recognise and comprehend information remains unchanging. After examining the theory and history of information design, Fry suggests that for visualisation design in the 21st century there is a seven step process which data must go through; from its original manifestation as unorganised sets of characters and numbers, with questions about the dataset as a whole, to an organised, visualised, understood and potentially answered subject.

This method is centred on the idea that data is best understood when visualised and Fry puts forth his own tool, the open-source, visual programming language Processing, as a technical platform to allow individuals tackle information design problems.

> *The visualisation of information gains its importance for its ability to help us 'see' things not previously understood in abstract data.*
> (Fry, 2004, p. 33)

Fry is a clear believer in the competency of visualisation to narrate complex data in a manner which vastly increases comprehensibility on the user end. This is illustrated successfully in his use of real-world examples, most notably his treatment of the human genome project. With approximately three billion letters of genetic code in each human cell, the human genome is perplexingly complex. Through his work in visualising large sections of this code, however, Fry allows medical and scientific professionals alike an opportunity to view the code from multiple perspectives and discover the relationships, differences and correlations within it.

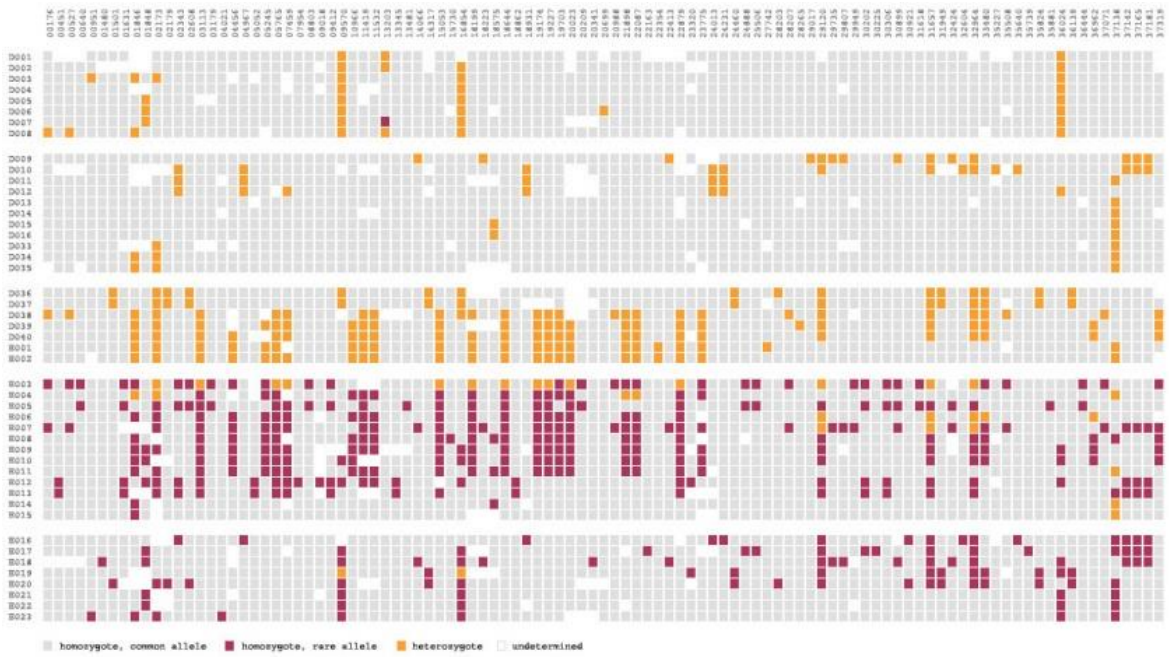

Figure 5. Excerpt from Benjamin Fry's pattern revealing, visualised genetic code.

He is unquestionably aware of both the universality and vastness of our modern data culture and he makes effective suggestions and observations about the means in which the information design community can provide tools for the public to find their way through the endless streams of information while also assisting understanding.

An interesting insight into the computer scientists' view of information design, Fry's writing both reinforces the work of those before him while making positive contributions to the progression of the field. His work was an invaluable resource in the construction of this dissertation, providing a thorough and thought-provoking insight into the workflow of one of the few and most respected contemporary individuals operating solely in the field of graphical information/data visualisation.

Popularisers of the Information Narrative

One thing apparent in this review of literature is that while many of the figures involved in the bodies of work recognise the potential for storytelling through information design, there are very few examples of its utilisation as a straight-forward, primary narrative device (Danziger, 2008). The argument of this dissertation, however, maintains that information design by its very nature is an implicit form of narrative. The collected works and research of the field discussed have only served to supplement this end. As

technological and design capabilities improve and advance, information design's ability to communicate wide ranging and complex subjects goes hand in hand with this progression.

Recent years have seen an influx of fresh faces come to prominence in the realm of information design. Seen as the popularisers of information visualisation, these figures produce aesthetically and visually compelling visualisations which succeed in narrating facts, figures, correlations and the various contextual relationships between them in an approachable, evocative, and exciting manner. It is not unusual now to find visualisations operating in the place of written explanation. Progressive news organisations, such as the New York Times, the Washington Post, and the Guardian all have embraced information design as a device to portray multifaceted stories in the areas of economics, global health and election results to name but a few (Segel and Heer, 2010).

Following the pattern set by Playfair, Nightingale, Minard and Tufte it appears that in each recognisable era of development in information design, there is an individual whose work towers over the others in the field as an example of the most advanced and prosperous performance in the domain. With achieved beginnings as Professor of Public Health Science at the Karolinska Institute, Sweden (Information and Public Relations Office, 2011), Hans Rosling has rapidly risen to become one of the rare famous faces of information design.
Through his use of animated, interactive visual presentations and the production and distribution of Gapminder data visualisation software (gapminder.org, 2008), Rosling has revitalised the practice of information design. Through his use of information design, Rosling uses adaptations of standard charts and graphs as a toolkit, to tell the story of global trends and phenomena in health statistics and human development with apparent ease. Not only this, but due to the far reaching success of his talks at the TED conference between 2006 – 2013 (TED, 2013) Rosling has succeeded in creating a global audience for popular information design.

An admitted acolyte of Hans Rosling and another champion of public facing, information narratives is David McCandless. His work as a freelance information designer and data visualisation consultant for the Guardian newspaper (Guardian News and Media, 2013) culminated in a published collection of information visualisation and graphics entitled 'Information Is Beautiful' (2010).

Similar to Rosling, McCandless utilises aesthetically vibrant information design as a catalyst for social awareness on subjects which he feels have a high rate of delusion and fallacy surrounding them. He is successful in achieving this through engaging the reader

and playing on the misconceived preconceptions that inspired his work to begin with. By taking an editorial approach to his design, McCandless facilitates a shift from traditional text based narrative journalism to graphic information narrative journalism. Both Rosling and McCandless are essential figures in a study of information design as a narrative tool, as contemporary leaders of the field and champions of effective and affective visual design. As they are central to the premise of this dissertation, both will be discussed further in Chapter 6.

While Rosling and McCandless are arguably the faces of popular information design within the mass media they are the representatives of a wider, changing tide within society and are by no means alone in their efforts to bring information visualisation to the fore as a driver of public information exchange through narrative. Newspaper articles (Cukier, 2010) and academic literature (Gershon and Page, 2001, Segel and Heer, 2010) have been seen to comment explicitly on the revelatory narrative and storytelling power of information visualisation, an indicator that the field may finally be on the road to achieving its true potential.

The scope of the literature surrounding information visualisation is almost overwhelmingly vast. A comprehensive range of topics are covered; from the beginnings of the practice, through its early evolution; to the development, mass diversification and exponential expansion within the field; the potential, limits and utilisation of graphic visualisation to date; and the anticipated future of the discipline. However, through careful and rigorous analysis, the literature allows us gain a valuable insight into the current state of the art and creates a platform for an in depth discussion on information design and its budding exploitation as a mass narrative device.

CHAPTER 4

DATA CULTURE: NEW RELATIONSHIPS WITH DATA

When presented with the challenge of designing a system that intends to visualise large quantities of data, often the most challenging of the elements to consider is how the system can accurately present the information to its users. Not only this, the display must also put forward an understanding of the bigger picture, or tell the story, that the information represents. In the 21st century, the emergence of a complex, data driven culture, has further complicated this quandary due to the oft-cited "information deluge" (Danziger, 2008, p. 29) which can be perceived as an overwhelming load on the architecture of modern information systems and a bombardment on our human cognitive abilities.

This metaphorical addiction to data is omnipresent and shows little sign of relenting. Data collection is the basic premise and primary driver of some of the leading and most ubiquitous internet based companies today. Massive corporate multinationals such as Google, Facebook and Amazon, to mention but a few, automatically collect, sort and store personal information about every user, on every visit to their website (Dover, 2008). Nathan Newman makes this point explicitly clear in his article for the Huffington Post entitled You're not Google's Customer - You're the Product (2011), where he suggests that the innovative products and services that these companies offer, often for free, are nothing more than bait used to collect usage statistics and to coax the public into parting with their personal information for the eventual profit of the company. The ideology and morality of data collection and mining techniques used by corporations is not a concern of this paper, the given examples, however, function to display a pervasive and undeniable manifestation of the extent and scale of digital information databases in the modern age.

It is not only the nature and presence of data that is changing, however. Our current relationship with data, as a public, is also considerably different than that of even relatively recent times. The widespread use and advancement of technology has allowed popular conceptions of information and data to evolve from static, recorded and archived entities to arrays of dynamic, complex and continuously changing resources. The examples of Google, Facebook and Amazon, while collecting information for their own gain, also serve to make available data that is accessible, explicit and interesting to the users of each service.

> *Particular technical developments…or…technology in general are the sole or prime antecedent causes of changes in society, and…the fundamental condition underlying the pattern of social organization.*
> (Chandler, 1995)

This oft-recounted, techno centric standpoint, aims to explain and rationalise the influence and hold technology has over modern civilisation. While technological determinism is a concept of perpetual debate amongst historiographical communities, it nonetheless acts as a suitable and apt foundation for an understanding of modern technological society. The proponents of the theory argue that the use of and reliance on technologies, is inherently in our nature as a species of learners and tool users. Today, the average internet user has an almost unlimited number of informational resources, dealing with an almost unlimited number of topics, at their instant disposal. Navigating through this information onslaught becomes a constant, while sometimes subconscious, process of information filtration and aggregation.

With this new, innate and increasingly ubiquitous connection with information in mind, it is naturally demanded that technological progression assists users to effectively explore and assimilate the magnitude of relative content on any particular topic. It is the argument of this dissertation that, the exponential growth and utilisation of narrative information visualisation in public facing displays, can be shown to be the manifestation of, and the response to, this demand.

In light of this, there is little doubt that the conceptual and relational evolution of data, paired with rapid and continuous technological advancements, leaves information designers in a unique and novel position. Never before has the opportunity to capitalise on the narrative and enlightening qualities of data visualisation been so great. The observable popularisation of information visualisation, in journalistic environments in recent years, is a testament to the idea that in this information age, information as a consumable resource is not exclusively of interest to professionals and experts. Run-of-the-mill users can now be seen to enjoy the experience of interacting with information all the while performing instinctual, internal analysis of the data; regardless of whether it is for academic or personal purposes.

Perception of Information

Analysing this exponential surge of interest and participation in narrative information visualisations has allowed us to gain an understanding as to what enables and contributes to the receptive effectiveness of visualisations.

A commonly referenced theory has emerged that the human brain is intrinsically wired to be predominantly responsive to visual stimuli. The close relationship and cooperation of the eye and the cerebral cortex (the area of the brain that is responsible for processing vision) create an information filtration and dissemination unit that is simply unrivalled by our other intellectual functions and sensory perceptions (Ware, 2012). Furthering this concept of vision as a powerful primary information receiver, the instinctive process of externalising cognition has always acted as an assistive tool to our finite mental capacity. A basic but effective example of this externalisation of cognition can be seen when one reflects on the considerable level of difficulty of carrying out a mathematical task on paper as opposed to in one's head (Card et al., 1999).

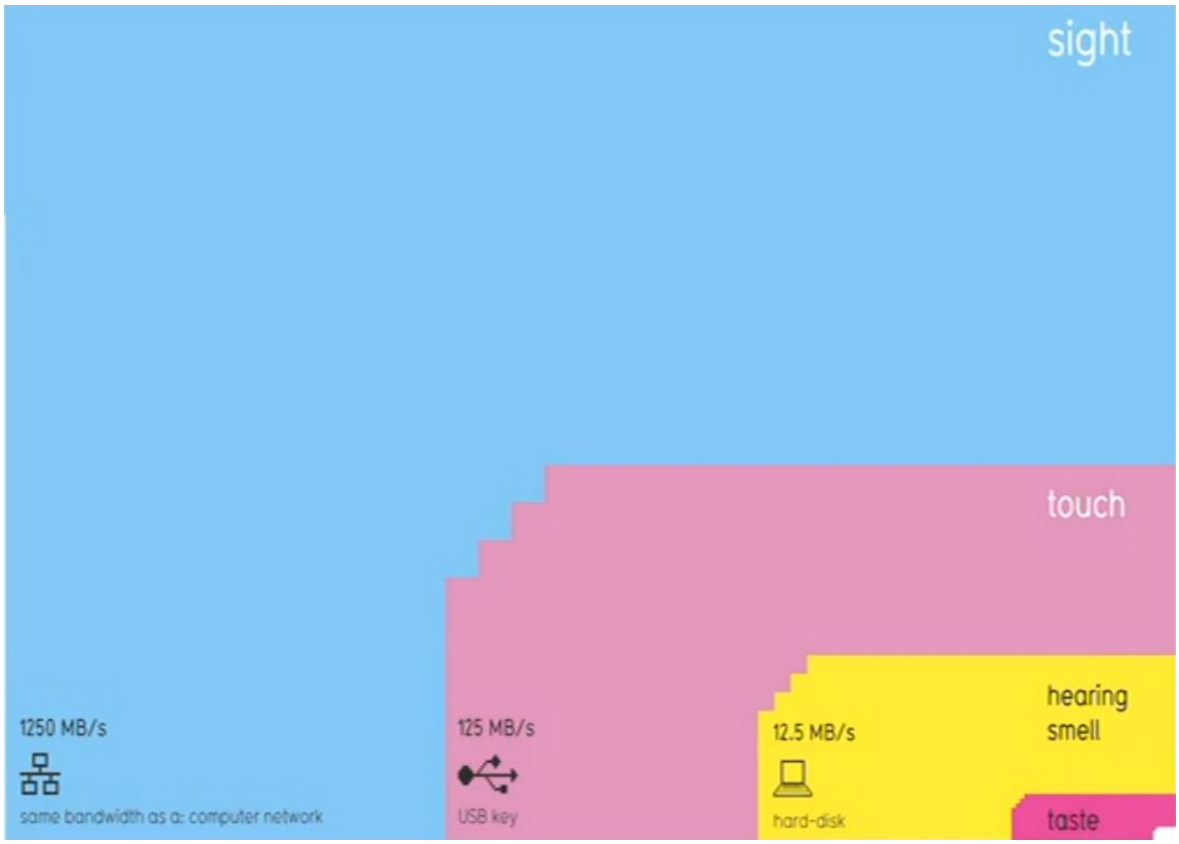

Figure 6. David McCandless' Low Resolution: Amount of sensory information reaching the brain per second.

In tribute to Tor Nørretranders' fascinating research in The Bandwidth of Consciousness (1991), David McCandless (TED, 2010) illustrates the division of perception amongst the senses. McCandless contextualises this division through comparison; using common technological bandwidths as a parallel metaphor to the human ability to process unconscious information.

Our knowledge of the innate cognitive ability possessed by people to make use of visual stimuli has always been exploited in effective information design. This is most often accomplished through the illustration of the most pertinent points of the visualisation with "pre-attentive" (Triesman, 1998 via Ware, 2012) features. These attributes of design encompass those elements of a graphic which are processed without the subject actively thinking about them (i.e. information unconsciously understood due to its salience) such as form, colour, motion and position.

Combining the use of pre-attentive features with enticing and aesthetically charged design allows information designers to attract users who otherwise may have little to no interest in the data content used to construct the visualisation. This is often the case with information visualisations which are aimed at narrating data to a wide public audience. As highlighted by Danziger (2008), information visualisation is increasingly used to raise awareness on issues of considerable social importance but command comparatively small recognition.

Practitioners such as Rosling are at the forefront of this public movement, using aesthetic and effective design to entice viewers to their mesmerising, memorable and informative visual displays. Evoking an emotional response through his allegorical visualisations, Rosling then grasps and maintains his users' attention through his elegant use of interaction.

Interactivity

Societies' newfound obsession with technology and data; a growing public penchant for visually evocative, story-telling visualisations; and most importantly, the vast and rapid development of new computational and visual technologies, has resulted in a new augmentation of information visualisation. Interactivity, a subject which is not considered in even the most esteemed surrounding information visualisation, is now a core component of data visualisation.

As is the case with Rosling and McCandless, and many other proponents of information visualisation for public audiences, the datasets they are attempting to visualise, are by nature, vast in the extremes. These massive datasets often consist of well over 100,000 numbers and can contain any number of variables (Hillman, 2010). The ability to organise and analyse these vast amounts of data, and subsequently add interactive functionality allows designers to build exciting, entertaining and enlightening exploratory applications that enable users to discover various different narratives within the data.

Interaction empowers the user to feel in control, and hence invested, in the data they are examining. With computer literacy at an all-time high, "digital natives" (Prensky, 2001, p.1), who view technology as an extension of their cognition, have come to expect interactivity as a fundamental component of information visualisation. It is interesting to consider that, often, the more statistically and computationally complex the visualisation, the more approachable it is to the user. As technology advances, programmers and designers are innovating to play on the computer-using publics' intuitions, constructing consciousness-altering, implicit narratives with great success.

CHAPTER 5

INFORMATION VISUALISATION: A STORYTELLING TOOL

From early beginnings of cave drawings, hieroglyphics and the development of writing with alphabetical systems; through the printing revolution and world changing inventions of mass communicative technologies, progression and changes in the way humans communicate has always gone hand-in-hand with societal development. Rooted in the age old tradition of oral storytelling, known by some as "the world's second-oldest profession" (Gershon and Page, 2001, p. 37), the activity of relaying information to others in the form of narratives has seen exponential variation and evolution since the dawn of the Information Age and the sophisticated mass media that are associated with it.

Traditional and Contemporary Narratives

The Oxford English Dictionary defines narrative as "a spoken or written account of connected events; a story" (Oxford Dictionaries Pro, 2010). Influenced by the convergences of technology, art and entertainment, information visualisation has emerged as a modern, compelling, efficient and affective mode of narrative communication. The combined capabilities it possesses are seen to stem directly from graphical representations ability to convey and reveal stories within data, features that are not always apparent when the same information is presented in other forms of communication (Danziger, 2008).

Under analysis, the narrative elements of information visualisation are not dissimilar in structure and composition to other, more traditional, narrative formats. Information visualisations, even when not specifically answering a direct question, function to initiate a clear discussion of the information within a given dataset. However, in a similar fashion to the societal and technological trends discussed in Chapter 4, methods used to visualise information and the means in which designers construct and reveal narratives through design are seen to be experiencing flux in recent years.

The pioneers of information visualisation such as Playfair and Minard, due to the technological constraints of their time, were creators and practitioners of information visualisations that presented pre-selected elements of information. The data had likely been meticulously analysed by the designer and highlighted the trends and features which the designer deemed appropriate to the graphic. This class of information design was extremely effective and stood the test of time, still appearing today in the form of print infographics. For this reason, the narrative characteristics of this style of information visualisation are well known and easily disseminated, and not of particular concern to this paper's argument.

Traditionally, extremely large data sets were exiled to crowded storage facilities; printed text documents hidden from sight in filing cabinets and cardboard boxes. In the digital age, however, habits of digitisation and an infatuation with data has stripped away the veil of intimidation surrounding the visualisation of large datasets. Contemporary, animated and interactive information visualisations are infinitely more robust and complex than the presentational graphics of old. These voluminous applications of information visualisation, often operating on a changing feed of raw data with numerous potential narratives contained, are designed with the intention of being explored by the masses and revealing their own embedded narratives in the process.

Designing the narrative features of data sets that deal with issues of massive breadth, such as global health or economics for example, is integrally different and proportionally more formidable than those visualisations which only have a limited scope. Often implemented to raise consciousness on issues of social salience, the purpose of this new form of visualisation is to design a framework which allows the data to tell its own story. Without incorporating a specific, pre-programmed narrative to the applications of information visualisation under discussion, the information designer can only strive to create as effective as possible a visualisation, assisting the user in conceptualising the information themselves.

According to Fry (2004), an emphasis on the visual quality of design within information visualisations is noticeably absent from a large proportion of the academic work carried out in the field. It is suggested that a level of practical ignorance is responsible for this, often because those tasked with designing modern visualisations do not come from a background of design and therefore afford visual design practices a lower level of importance than concentrating their resources on safeguarding the accuracy of the raw data itself.

This practical ignorance; possibly rooted in the all too common misconception that visual design practices only serve to make a visualisation "prettier", can have far reaching and cumulative consequences. Miniscule, but still design oriented, adaptations made to individual elements of a visualisation may not seem important when the visualisation is static and concerned with a simple dataset. When burdened with visualising the large and multifarious datasets we are considering in this paper, however, these miniscule adaptations are magnified. Any element level design flaws are then also magnified throughout the entire visualisation, hindering the accuracy and effectiveness of assisting understanding of the content. It is undeniably clear that simply visualising the information at hand is not enough; designers must strive to produce accurate and effective visualisations in order to create and foster successful narratives.

Structural Narrative Design

Through the addition of interactive functionality and the application of information design principles to the visualisation as a whole, exploratory and storytelling value is added to an information design visualisation. This value is then enriched further as the popularisation of social media, and the almost ubiquitous incorporation of "share" buttons on the web, allow for an aggregated, human analysis of information and significant contextual elements within.

> *I think people have begun to forget how powerful human stories are, exchanging their sense of empathy for a fetishistic fascination with data, networks, patterns…. Really, the data is just part of the story. The human stuff is the main stuff, and the data should enrich it.*
> (Jonathan Harris, via Segel and Heer, 2010, p. 1140)

Jonathan Harris, creator of the popular "We Feel Fine" and "The Whale Hunt" interactive narratives, and pronounced advocate of visual storytelling, is exemplary of the results achievable when consideration is paid to the link between interactive functionality and narrative exposition (2012). Allowing users to explore information at their own pace and in their own style generates a symbolic rapport between the designer and user, but also creates a sense of emotional engagement in the user with the visualisation. While users are essentially free to discover the information in the visualisation as they please, they are still, always, at the mercy of the designer's competency and ability to incorporate the tools which accommodate this end.

In the same way that a talented oral storyteller can draw a listener in with their art, a designer can evoke an emotional response from a user through their utilisation of known design and interactivity techniques. In doing so, they enable the story within the visualised data to tell itself, playing on the viewer's curiosity, reactions and intuition.

Manipulating the structure of the visualised information has considerable effect on how a user identifies with the information placed before them. Framing the conversation in this manner allows us to think about the creative process of information design as a craft, combining the expertise of statistical analysis, technical ability and artistic originality. Drawing from the design practices of the wider field of modern storytelling, visualisations can incorporate assortments of media types, from text and images to video and audio extracts. Reminiscent of Marshal McLuhan's insight, "the medium is the message" (1994), it is not surprising that the fashion in which these various elements are presented has as much influence on the narrative potential of the visualisation as the accuracy of the information itself.

Contextual structuring allows the user to gain an overall sense of the contents of the visualisation and to keep a track of their position and progression within the visualisation. Introductory mechanisms, such as an establishing shot, checklists and indications of consistency within the platform (colour, layout, size, etc.) which have parallels in other narrative fields such as film and print publications, give the user a clear indication of the context and possible modes of development of the narrative. Progress trackers, such as timeline sliders or zooming functionalities not only allow users to retain this sense of context as they advance their exploration through the information, but also enable users to retrace their own path and explore different avenues along the narrative progression or simply refresh their knowledge of prior elements.

Attention grabbing elements which propagate instinctual reactions via pre-attentive cognition, such as colour, motion, framing, size and audio, highlight essential ideas within the dataset and direct the viewer's eye. Due to the vast range of the information in question, and the limited size and resolution of modern displays, it is unlikely that all of the information will be visualised in any single space, and transitions between scenes must be considered. While these transitions may manifest in various forms, a long-standing narrative technique from the school of film, continuity editing, can be utilised to minimise user disorientation.

The examples of visual and interactive tools outlined above are by no means exhaustive. They do, however, serve to show the degrees to which the designer maintains control over the narrative style of the information design, regardless of whether the visualisation is large, small, static or dynamic. A vitally important point for designers to note is that the users of these applications are emotional beings, and emotions have a strong influence on interaction (Isen, 1990). Engaging these emotions must be central to any employment of information visualisation design, as it both encourages interactivity and reinforces the already established rapport between designer and user.

The effectiveness of a visualisations narrative exposition is highly dependent on the ability of the designer to balance and implement the skillset of a film director, a graphic designer, a statistical analyst and a psychologist. The amalgamation of these skills allows for creative information narratives that toe the line of informative, entertaining, aesthetic and engaging design.

CHAPTER 6

THE POPULARISATION OF INFORMATION DESIGN

In order to better understand and portray the effectiveness with which information design can act as both an accurate representational tool and an engaging storytelling device, an in depth look at the current leaders of the field and their work proves extremely beneficial. Recent developments on the internet have led to a popularisation of information visualisation as a narrative device, manifesting itself in various forms. From multitudes of TED talks, to central roles in feature films (Ware, 2012), to seminal publications of nothing but 256 pages of pure data graphics (McCandless, 2010); information visualisation is experiencing a fundamental change. It is no longer an expert analysis tool, locked away in the laboratories and offices of professionals. It is now a widely utilised, public facing, mass medium for communicating awareness of pertinent and prominent information and statistics.

Due to the limited scope of this paper, however, an in depth critical analysis of the tools used by the modern pioneers involved in the field as a whole would prove cumbersome and inefficient to the argument at hand. Sifting through examples of the most advanced and contemporary literature regarding the modern discipline of animated, exploratory information design, resulted in a number of practitioners appearing to rise above others in regards to their contribution to the advancement and popularisation of the field.

Modern Pioneer: Hans Rosling and Gapminder

The single most prominent of these experts is Hans Rosling. First appearing on the information visualisation scene in his still popular talk on the topic of human development trends at the Technology, Entertainment and Design conference 2006 (TED, 2013), Hans Rosling is the co-founder of the Gapminder foundation (2008). Beginning his career in the medical profession, Rosling made the radical career change to avant-garde statistician and visualisation expert, when he became concerned about the lack of public facing information concerning the continued development of the world with regards to health, wealth and various other associated narratives. Potentially unaware of the wider scope of his work at

the time, Rosling was embarking on a path which would see him becoming the popular face of information visualisation and a mentor to up and coming information designers.

Founded by Rosling, his son and daughter-in-law only a year before it's unveiling at TED, Gapminder is a non-profit organisation which outlines its mission statement as "fighting devastating ignorance with fact-based worldviews everyone can understand" (Niño Zambrano and Engelhardt, 2008). More specifically, their primary goal is to promote the mantra of sustainable global development in line with the UN Millennium Development Goals, by increasing the use, accessibility and understanding of the relevant statistics.

Central to the practical viability of achieving this goal was the foundation's development of an information technology platform which enabled them to visualise, in an easily understandable way, the statistics and information which they felt warranted public discourse. The result of this development process came in the form of a software package called Trendalyzer. Based on an earlier, more primitive manifestation as the World Health Chart 2001 (Rosling et al., 2005), Trendalyzer is a visualisation package which turns time series statistics into attractive, animated and interactive graphics. The software was built bearing a very basic premise in mind, one which rings true with the overall argument of this paper, that "visualization in moving graphics is an intuitive method for understanding relationships and it is an excellent way to exhibit patterns…transforming statistics into understanding" (Rosling et al., 2005, p. 4).

While Rosling's video presentations are highly entertaining, and his ability to present the information to the audience undoubtedly has effects on the information's perceived salience, it is the visualisation software behind his performances which are of interest to this paper. Utilising the storytelling potential of the Gapminder software, Rosling, after a brief personal introduction, makes a moving and wholly absorbing presentation which features "bubble-charts" and "scatterplots", animated graphs pioneered by Rosling which display quantitative data in the form of annotated lines, points and shapes. Coupled with a variety of animated transitions the result is a display which captivates and navigates the audience's attention through a vast exploratory visualisation.

Gapminder: A User's Experience

Available for use by the general public, an experience with Gapminder begins with an establishing shot showing a grid of various possible starting points from which the user

can commence exploration of the entire dataset (Segel and Heer, 2010). Using apt imagery and clear, concise labelling, the user is able to quickly identify the scope of the visualisation as a whole (income, poverty, health, deaths etc.). Accompanied by a progress tracking navigation bar, the user instantly has an intuitive sense of the structure of the information and becomes aware of the possible routes they can embark on. A large "Start" button in the bottom right hand corner initiates the animated content (usually a time-narrative progression), which, when pressed, turns into recognisable web-browser style 'forward' and 'back' buttons. This simple combination; an establishing shot, navigational progress bar and step browser buttons enable users to feel in control of their viewing of the information. Browsing the application in their own time and in their own preferred direction, the information is not forced upon them; rather it is liberated for their consumption.

Consistently using size as a representation of value (often population), and colour (country or continent), Rosling's "bubble-charts" have become, to some degree, an industry standard for multiple-variable visualisations (McCandless, 2010). While Rosling makes use of three different chart types within the software, no one section makes use of more than one type. This creates a sentiment of semantic uniformity and allows users to easily follow changes and movement as the narrative progresses. When a change in chart type is needed, Rosling makes very prominent use of obvious animated transitions over a number of steps to avoid jumping between graphics and hence confusing the user. Often, these transitions are pre-empted by annotation describing the transition before it happens, a tool which both assists the user in keeping track of the fast paced progression of the visualisation, and also serves to keep the narrative within its finite bounds.

At any given starting point, a combination of step-transitions, annotations, highlighting and interactivity serve to explicate the data set in an overt and unambiguous manner. Pre-emptively qualifying his eventual students' quote "data is the new soil" (TED, 2010), Rosling pioneered a technique of building and assembling his visualisations in a stepwise manner. With annotation, highlighting and narration explaining each step of the process, nothing makes it onto the users screen without a contextual explanation. Aimed at avoiding ambiguity and viewer oversights, this often begins with a blank axis, with introductory comments explaining the nature and domain of the variables which are about to be presented. This procedural construction of the visualisation allows users to easily follow the progression of the data, even when the scope of the visualisation is far-reaching and complex. It also serves as a secondary highlighting mechanism and vital narrative development tool, as adding key data points has effects on the relevance and importance of the already plotted information, exposing new elements and perspectives on the narrative.

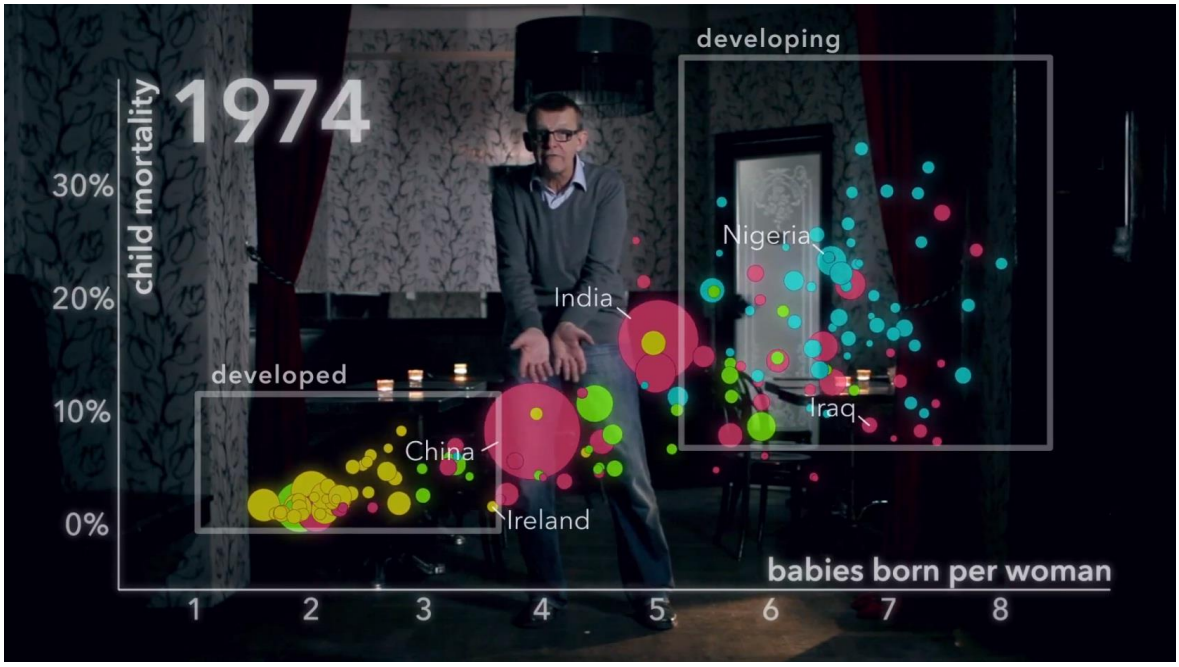

Figure 7. Hans Rosling demonstrating his *Gapminder* visualisation software in *The River of Myths* for the Bill & Melinda Gates Foundation.

Similar to the step-by-step approach, the annotation used also has a multi-faceted functionality. Aside from its obvious use introducing and identifying graphical features, the comments also serve as plot points for the developing narrative, providing generalised observations that the user may not have identified in a casual viewing of the visualisation. These narrative guiding devices assist the overall narrative utility of the visualisation, allowing the animation to progress at a liberal pace without losing clarity; all the while presenting dense, intricate information.

Recognised as utilising a general martini-glass structure, the visualisations in Rosling's Gapminder software often begin with a pre-directed approach, allowing increased user interactivity as the author driven narrative comes to a close (Segel and Heer, 2010). This is most evident in the programs implementation of the timeline slider. During an animated visualisation, the slider is merely a timepiece, giving the user a sense of position and context in the overall dataset. When an animation is not active, however, the user is encouraged to use the timeline slider as a navigational device. It can be used to peruse different time series of the same dataset, in order to discover the yet unexplored narratives. In this manner the interactivity acts as an extension of the presented narrative, emphasising the point that the software is an awareness raising tool and not simply a linear narrative communicated from designer to user.

Changing Attitudes and the Future of Information Visualisation

Rosling's endearing presentational personality, and captivating stage presence, is hard to ignore. He personally shoulders responsibility for at least a portion of Gapminder's success and reception. It is the argument of this paper that without an effective, resilient and convincing visualisation platform to build his "mindset changing" presentations with, Rosling's appeal and successive fame would be non-existent. Tribute must be paid, however, to the contribution Rosling has made with regards to changing the public's attitudes towards the concept of statistics.

While this area of visualisation, and indeed the Gapminder tool itself, are yet to be the subject of any form of rigorous or formal research; the effectiveness of this tool and its methods of information visualisation are undeniably evident when consideration is given to its inimitable, undeniable and unparalleled popularity since its public debut at the fateful TED Conference.

Following Rosling's seminal appearance at TED 2006 the Trendalyzer software was made available, for free, under the name Gapminder Desktop. Utilising statistical data obtained with the assistance of the UN Statistics Division (United Nations, 2010), Gapminder presents interactive time-series maps of worldwide infant mortality rates, income per capita amongst many other developmental measures which bring the "potentially dry statistics to life" (Arthur, 2007 via Niño Zambrano and Engelhardt, 2008).

Riding on the wave of publicity generated by this inaugural TED talk, Rosling and Gapminder have since gone from strength to strength, re-appearing at various international TED conferences, amassing a total of nine presentations. The internet-savvy public began to take notice of his personality and his work, eventually inspiring the BBC's semi-biographical, semi-showcasing documentary on Rosling's colourful career and the work of the Gapminder organisation. Broadcast by the BBC a total of twelve times since 2010 (Hillman, 2010), and rehashed in the form of short, digestible YouTube clips, The Joy of Stats and Gapminder's online videos show the self-titled "edutainer" and his striking, storytelling craft at their very best. Rosling has become something of an international celebrity and an irrefutable authority on the visual presentation of information, with a running total of

almost twenty million views on both TED.com and youtube.com1 as evidence to this end (Gapminder videos, 2007, BBC - Highlights from the BBC, 2010, TED, 2013).

If the indisputable public following for information visualisation in the entertaining, usable and empowering format which Rosling produces was not enough to verify the effectiveness of Gapminder; the professional world also began to take notice. Endorsing and supporting Rosling's message, and more importantly, the medium with which he conveys it, Google's acquisition of both the Gapminder software and team (Google Official Blog, 2007) ensured the visualisation advocate and his software a secure place in the future history of information design literature. Winning awards in the field of statistics, science and design; Rosling has been named in Time magazines The World's 100 Most Influential People (Christakis, 2012) and earned himself the title of Statistician of the Year from the Swedish Association for Statistics (gapminder.org, 2008).

Lending his expertise to massively influential public figures, such as Al Gore on his film An Inconvenient Truth (Guggenheim, 2006) and producing narrative visualisations for the Bill & Melinda Gates Foundation (2013), there is little doubt that Hans Rosling is the face of a "new era of visualisation" (Kosara, 2007) where data, statistics and information are consciously represented visually as opposed to in plain text. Already informing and addressing the public in a manner which "unveils the beauty of statistics…going beyond the eye to hit the brain" (Rosling et al., 2005, p. 522), it would appear that under the guidance of Rosling and his successors, the future of information visualisation and design is clear, concise and beautiful.

[1] Based on official TED.com statistics, and TED & Gapminder official youtube.com channels.

CHAPTER 7

CONCLUSION

As the information age continues to develop, the practice of visual information design is seeing exponentially increasing utilisation as a narrative tool in forward facing, public applications. This trend will undoubtedly persevere, leaving information visualisation standing as a major player in the communicative practices of the current and future generations. Far from its roots, information visualisation is now on the verge of becoming a popular mass medium. In order to better understand this change of role, this paper has attempted to draw attention to the academic, human, societal, technical and systematic contributing factors influencing this significant, palpable, paradigm shift.

The statistical graphs which appear in the published works of William Playfair (1786) represent the first widely recorded instances of information visualisation. Since that time, academics and experts alike have pondered over the perceived communicative effectiveness of the visual display of information. From the mass appal sparked by Florence Nightingale's whistleblowing Crimean War graphics (Cohen, 1984), to the momentous, progressive and inspired reactions to Hans Rosling's captivating, eye-opening visualisations (TED, 2013), there is now little doubt surrounding the relationship between the storytelling capacity of qualified information design and our instinctive, human appreciation and penchant for visually stimulating communication.

As is the case with almost any academic field, even the most contemporary and innovative practitioners of information design have formed their craft by referencing and drawing on a rich library of past works. Simply looking at a chronological timeline of events and achievements of practitioners, however, does not allow us to come to a critical understanding of the nature of this development from previous norms to the current observable practices. Looking at, and critically analysing, the fore fronted and most oft-cited examples from each distinct period of information design's history, a clear trend begins to materialise; that the growing implementation and reception of information visualisation as a mass narrative tool is wholly intertwined with both technological development and societies' prevailing relationship with, and access to, information.

Even the most traditionally celebrated and respected literary figures on the principles, foundations and conventions of information design, such as Edward Tufte (1997, 2001, 2006) and Robert Horn (1998, 1999), can be seen to suffer diminishing influence in the contemporary domain as a consequence of this basic affinity towards transience and development. While their contributions to the progression of information design and it's exposition as an apt narrative tool for quantitative and statistical information are arguably indomitable, the technological restrictions of their time sees a majority of their work left in the annals and archives of a period when static, small scale visualisation was the leading form of information visualisation.

The information age, in which history currently resides, is named so because it can be distinctly characterised by an unprecedented and constantly proliferating process of information production and technological ubiquity; dwarfing that of entire previous eras in a mere number of years. As a naturally adaptive species, the human race has taken to this technologically driven period with an almost instinctive finesse. A generation of digital natives (Prensky, 2001) has emerged who are extremely comfortable using various forms and mediums of technology to navigate extensive information spaces and databases as an intrinsic part of modern daily life.

However, as the rate of technological advancement far surpasses the rate of natural human evolution, there is a constant and daunting risk of information overload as our limited cognitive abilities struggle to keep track of, and analyse, the relentless barrage of information on our senses. This paper argues that, because of this combination of technological advancement, changing cultural relationships with information and data, and the versatile practice of information design; information visualisation has established itself as a capable, tolerable and growingly popular method for communicating large amounts of complex information to wide ranging audiences in a comprehensive manner.

As the nature of contemporary information is fundamentally different than that of previous eras, so too are the tools and methods available to those attempting to design visualisations based on modern datasets. New data mining, aggregating, analysing and presentation techniques have seen the practice of information design evolve from producing primarily inert, rigid graphics to creating dynamic, expansive, interactive and engaging applications. The advent of modern computational methods and the capabilities of contemporary displays have resulted in increased interest in the development of systems capable of presenting visually compelling information in a manner which deems it more comprehensible than its abstract or text based counterparts.

The potential of these systems is beginning to come to fruition, as the prevailing rhetoric around the need for an integration of the many different skill streams which information visualisation draws from into a single practice, is starting to be realised. With high public profile individuals versed in the professions, academics and crafts of graphic design, statistical analysis, computer programming and communication such as Benjamin Fry (2004, 2007), David McCandless (2010, 2010, 2013) and Hans Rosling (2005), this paper contends that a glimpse of the possible future scope and implementations of information design and is becoming apparent.

With open-source production tools such as the Processing language (Fry, 2004, Reas and Fry, 2007) and easy to learn, easy to use implements for general consumption such as the Gapminder software (gapminder.org, 2008), it is undeniable that information visualisation is no longer a subject of exclusive concern to experts. On the contrary, part in response to the public facing displays of information design from those individuals mentioned above, and part in reaction to an increased desire to understand the workings of the world around us, the general conception of information design as a narrative tool categorises it as an entertaining and effortlessly followed narrative form.

Initially implemented by Rosling to alert people's consciousness towards issues of public health, world development and international poverty, with the quip "let my dataset change your mindset" (TED, 2010), the use of information visualisation as an awareness raising device for issues of considerable public consequence and substance, has been echoed by many. Most notable are Al Gore and his use of information design to convincingly display the true relationship between Co2 emissions and global warming (Guggenheim, 2006), and David McCandless' graphics containing overwhelming revelations, presented in a visually stunning manner (McCandless, 2010, Guardian News and Media, 2013); both of which were received with great public acclaim.

This paper contends that these implementations are the mere beginnings of a widespread proliferation and ubiquity of dynamic, interactive, information design as comprehension and cognitive assistant. The clear narrative qualities and competencies of visualised information have brought the realm to the cusp of mainstream utilisation and a select few individuals are working relentlessly and successfully to achieve this end.

Through the use of up-to-date information visualisation systems, and a sustained, albeit subliminal, cultivation of the need for omnipresent and freely accessible visualised

information, an intuitive critical competency for information design has emerged. Like any literal work, the users of information design should be able to think analytically about the design, content and structure of any given visualisation to gauge its contextual relevance, its accuracy and its scope.

While it is beyond the confines of this paper, it is important to recognise that in order to fulfil the true potential of information design and its voluminous narrative abilities, this essential literacy should be taught in establishments of formal education. A core component of the Gapminder movement (2008), attempting to bridge the gap between the semantics of modern information design and those of the basic graphs and charts frequently taught in elementary level schooling is essential to equip the next generation of users with the skills of critical analysis needed in an age of ubiquitous information design.

In conclusion, the practice of information design is experiencing a significant paradigm shift and on the verge of mainstream utilisation as an effective narrative tool. Through the critical analysis of the contributing factors to this archetypal development and refinement, the need for widespread aesthetic analytical and meaningful information design has been illustrated. While the future of any domain is never a certainty, the examples of contemporary, pioneering practitioners and tools discussed in this paper would indicate that the future of information design is altogether different than its past, a positive driving force in the development of societal cultures and trends, and very much in sight.

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IMAGES

Figure 1. Example of William Playfair's early time series graphs. Doug McCune Blog. Accessed 24/02/2012 <http://dougmccune.com/blog/wp-content/uploads/2010/01/playfair_ireland.jpg>

Figure 2. Florence Nightingale's original Rose Diagram. Wikipedia. Accessed 24/02/2012 <http://upload.wikimedia.org/wikipedia/commons/1/17/Nightingale-mortality.jpg>

Figure 3. Charles Joseph Minard's graphic visualising Napoleon's 1812 Russian campaign. Wikipedia. Accessed 25/02/2012 <http://upload.wikimedia.org/wikipedia/commons/2/29/Minard.png>

Figure 4. While a visually pleasing, multi-functioning graphic; Tufte (2001) argues that the use of sixteen colours transforms this image into a crypto-graphical puzzle. (Tufte, 2001, p. 153)

Figure 5. Excerpt from Benjamin Fry's pattern revealing, visualised genetic code. (Fry, 2004, p. 62)

Figure 6. David McCandless' Low Resolution: Amount of sensory information reaching the brain per second. Screenshot from (TED, 2010)

Figure 7. Hans Rosling demonstrating his *Gapminder* visualisation software in *The River of Myths* for the Bill & Melinda Gates Foundation. Screenshot from (Gates, 2013)