Exploring the Value of Casual Infovis

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ABSTRACT

Many untrained humans can efficiently and intuitively understand a visualization of data and publicly available casual information visualization tools provide a potentially powerful way to understand various questions and issues across disciplines, education levels, and possibly beyond the limits of literacy. The purpose of casual infovis could be non-analytic, artistic, qualitative instead of quantitative, reflective, social, entertainment, awareness raising, or more darkly it could spread negative knowledge or false influence. There are many attributes to consider when discussing the value of the wide variety of casual infovis. Casual infovis is good for the public because it provides opportunities for insight, innovation, storytelling, or aesthetics, and it's good for traditional infovis because studying edge cases like casual infovis can provide insight into central problems and opportunities in infovis, help develop new vocabulary, and also complement the traditional infovis focus on expert analytic tasks [20].

KEYWORDS: casual information visualization, data visualization, value, aesthetics, non-expert

1 INTRODUCTION

Demand for understanding of data drove the development of the field of information visualization and the rise of the needed experts in statistics and computer science. As infovis satisfied the immediate utilitarian needs of the customers in medicine, engineering, science, government, and business, they began to settle and be less innovative at the core of the expert and professional area [16].

But on the edges, things started to expand, to be applied in creative ways, and without needing an expert anymore. Researchers found new areas to study including what laypeople would do with information if given the chance to make their own visualizations with simple online tools. [32]. Others in the infovis field expanded the marketing and social uses of infovis [33]. There are many more examples of a huge variety of casual information visualization purposes.

2 CASUAL INFOVIS

Casual infovis is information or data visualized for some meaning or purpose that is outside the center of traditional, expert infovis. Casual infovis is intended for a range of audiences from broad public to individual, from informal settings to formal, and created by a range of skill levels including children and pets that just happen to be there in the surveillance. There are many terms used to describe this edge case area of information visualization, including: infographics, data [or info] vis, and info [or information or social or journalism] data visualizations.

Generally accepted definitions of information visualization include the use of computers to interactively amplify cognition using visual representations. Pousman [20] separates traditional infovis from casual infovis by noting the differences in:
- users - wider public

- application and use
- data type - explicit and also connotative
- user's relationship to data
- insight is less analytical

Images created to represent information about data are interesting because they are visual shortcuts to the human understanding and can be intuitively absorbed. John Grimwade put it well when he said to turn the light on, not turn it off. "Everything in a graphic should work to help people make sense of complex information" [7].

Kosara separates infovis into pragmatic and artistic, with the pragmatic being inherently technical, analytical, and computer science based rather than design based. He defines a visualization as based on data, producing an image, and the result is readable and recognizable with the intent to communicate data [12].

Studying the differences between pragmatic and artistic visual communication provides an opportunity to build a language and principles for the scientific discipline of information visualization [12].
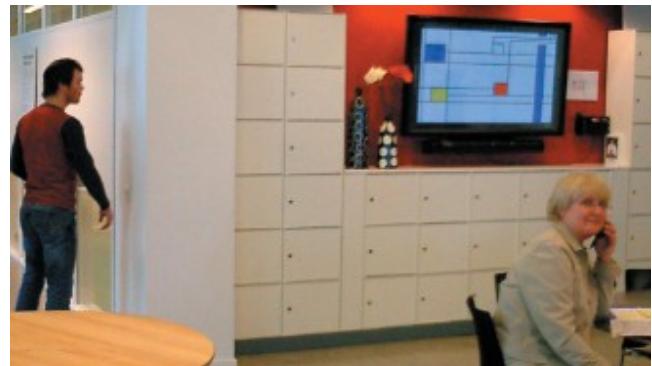

Fig. 1. Skog, Ambient Infovis of bus schedule, styled after Mondrian [22]

But casual infovis does not have to be a printed graphic or a personal computer screen image. It can also be ambient, which means that it is just present in the user's environment, but still providing valuable information in an attractive way [22]. Skog offers his bus timetable example which provides time sensitive, localized information to the real world through a screen displaying a Mondrian-like graphic, shown in Figure 1. Ambient infovis has different challenges from traditional infovis because users are untrained, there could be no interactivity, and animation might be distracting if the ambient infovis requires glance-able readability [22].

Ambient infovis verges into "informative art" [22] where efficient transfer of information is not a criteria. Aesthetic concerns become primary in partnership with some generalized information display, not really multivariate, but instead just simple data like time passing or movement of people, among other topics [22]. An example is the "Last Clock", a video surveillance in a public area capturing time and motion and mapping seconds, minutes, and hours in a completely non-utilitarian way and intended only as art [28].

2.1 Purposes and Types of Casual Infovis with Examples

There are many purposes for casual visualizations. Some are explanatory, some are evidence, some are revelatory, some are exploratory, some are art, some are accidental. One problem is how to separate the casual from the professional? There is quite of bit of trickle out from professional to the general public. And the principles of good visualization, although expected from professional work, are not always followed, even by pros.

New types of casual infovis are probably being invented all the time, but limiting this discussion to the basic requirement of using data and visualization, we can include the following types:

- ambient
  - information visualization, e.g. bus stop schedule [22]
  - ambient single variable, e.g. ambient orb [20]
  - infocanvas [20]
- personal data and personal finance
  - Smartmoney's Map of the Market [online, 65]
  - Digg.com's "Stack", "Swarm", and "Arc" visualizations [online, 66]
  - slife [online, 38]
  - photomesa [online, 67]
  - Nicholas Felton's Annual Reports [online, 68]
- social visualization
  - PeopleGarden's "data portraits" of online interaction environments, meant to orient users to each other [35]
  - "The Dumpster", a visualization of romantic breakup blogs for 2005 [online, 57]
  - "wefeelfine.org" which mines the web for "I feel" and then catalogs the weather, location, age of the author, and visualizes it [online, 54]
  - e.g. vizster, social network Friendster graph (self adjusting attractive/repulsion graph) [8]
  - themail, counts words in email and shows as bar graph [online, 60]
  - technology support for tagging of digital artifacts
  - spaces for collaborative web bookmarking, e.g. del.icio.us [online, 48]
  - news, e.g. digg.com [online, 66]
  - public space, e.g. plazes.com, yellowarrow.org [20]
- artistic work that visualize information
  - e.g. "Artifacts of the Presence Era" by Viegas [28]
  - can be far from functional goal of traditional infovis – challenging assumptions about what constitutes data and focusing art on computer infrastructure like the network or algorithms [20]
  - "Tableaux Machine" uses cameras throughout a house to capture activity and "togetherness", then creates an abstract painting with no direct mapping to a space or person [21]
  - Ray's Visitor.Files is human collected data on traffic, temperature and weather then using strict mapping to visualize but is painted by hand, a human instantiating the algorithm instead of a run of compiled code [20]
- world trends and education, e.g. gapminder.org [online, 40]
- measurable topics like energy use [vampire energy video [online, 39]] or diet and exercise behavior [20]
- persuasive visualization: e.g. Andres de Valle and Opalach built a prototype of a Persuasive Mirror, figure 2 [20], that would monitor a user's diet and display the future (heavier, thinner, unchanged) when the user

looked in a video "mirror"; recently purchased by Accenture
- journalism like NY Times online [onling, 63] which is an entire field by itself

Fig. 2. "Persuasive Mirror": screen showing future self, recently purchased by Accenture [20]

When infoVis is art, is it still a cognition amplifier? Pousman answers, "This is clearly not the same kind of amplified cognition that genomics researchers or financial analysts come to, but there is more to cognition than merely insight for work tasks. These systems may trigger us to reflect on our lives, our worlds…[or] may help us in meta-cognition, thinking about our own thinking" [20].

2.2 Relevance

Data and information visualizations have been used in analysis and decision making since cavemen could draw with a burnt stick. Casual infovis is poised for growth. The pervasive presence of the internet makes presenting data in new ways feasible, thus seeding the expectation that information visualization will become mainstream [4]. Viegas promotes casual infovis by pointing out that "interactive visualizations [are] a key medium for communication in a data-rich world" that can inspire storytelling and analysis collaboration [32].

Because of increased computing power and the internet, it is now possible to manipulate huge data sets into visualizations. Laymen can potentially create infovis that have meaning to the general public. What kind of watchdog is there for false information visualizations? Does there need to be any division between lay and professionally created infovis? As Grimwade says, "this is not a problem at all, until… wild visualizations start masquerading as infographics" [7].

Growth and evolution of visualization is inevitable. The analogy between infovis and photography [6] points out that cameras were originally only for specialists and as they became more and more available, including the tools to manipulate photographs, there were concerns that photography would be damaged by this popularization. But the public learned to be critical thinkers about photographs. It didn't hurt the field, it opened it for innovation and created demands for new products.

Unfortunately, "Information visualization is still a novelty for many users" [19]. There are a few commonly used applications that are exposing the public to visualizations by incorporating time lines or mappings into their mainstream tools, for example Adobe Photoshop and MS Outlook. Better metrics for proving to the public the benefits of visualizing data would accelerate adoption of visualization techniques [19].

Journalism is effective in exposing the public to the power of casual infovis. Possibly this can spillover into other casual infovis uses.

Information can be power and gaining insight through visualization can be a powerful tool, therefore casual infovis is relevant to the non-expert public.

> "Our networks are awash in data. A little of it is information. A smidgen of this shows up as knowledge. Combined with ideas, some of that is actually useful. Mix in experience, context, compassion, discipline, humor, tolerance, and humility, and perhaps knowledge becomes wisdom." [69]

3 DISCUSSION OF VALUE

For casual infovis to be valuable, it must have positive attributes, serve a purpose, solve a problem, and be usable and accessible.

Value can be objectified, quantified, measured, and abstracted to fit a variety of infovis, as Van Wijk does in modeling the value in mathematical terms and quantifying the abstraction of a variety of infovis purposes and effects as shown in Figure 3. Using formulas to identify knowledge gained through visualization is a good way to measure, but it may not be a good fit for the non-utilitarian types of casual infovis. [27]. Here the change in knowledge is calculated over time as a function of the user's existing knowledge and their perception of the image.
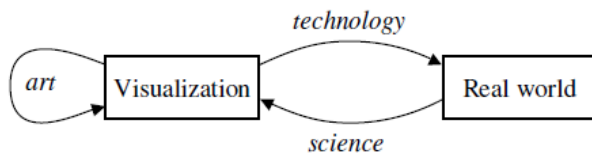
$$\frac{dK}{dt} = P(I,K).$$

Fig. 3. Van Wijk, model for infovis (above) and formula for cost benefit of infovis (below) [27]

Visualization can have value through serving as an "authoring tool" instead of just a method of analysis." [30], as exampled by the popularity of wordle.net. Wordle is in wide use by school teachers with their classes and many users report that beauty, organic shape, emotional impact, and attention keeping visuals draw them back to wordle.

Value can be subjective. Viegas reminds us of the storytelling and shared memory value of visualizations of socially meaningful public or private digital archives, such as photos, email, and newsgroup archives [29]. Sedimentary visualizations of archives can reveal conversation trends, evolving habits, and even possibly "fossils" that are unwieldy to find in writing but comprehensible in visual form, as exampled by Viegas's sedimentary visualization of archived movement surveilled from a public space, shown in Figure 4 [29].

Non-utilitarian infovis could have value, or maybe not. Kosara points out that there are visualizations that use the techniques and ideas of information visualization but without conveying anything, they are not utilitarian and make no sense either as pragmatic or artistic infovis [14]. Other times, an infovis may be interesting as art, have the sublime quality that Kosara advocates, but as soon as one knows what information it is representing, it ceases to be interesting as art, what Kosara calls the "Heisenberg Principle of Visualization" [14].

As edge cases of infovis continue to evolve, Kosara argues that infovis will have no value if visualizations are more and more broadly defined. Infovis becomes meaningless. "There's about as much visualization in these images as in an actor depicting a scientist in a tv commercial" [15].

Fig. 4. Fernanda Viegas, "Artifacts of thePresence Era: Using InformationVisualization to Create an Evocative Souvenir", 2003, Institute of Contemporary Art [29]

3.1 Attributes

There are many attributes that can be considered when seeking value in a casual infovis. Some come from traditional, utilitarian infovis, some come from graphics and product design, and some are unique to the unlimited purposes of casual infovis.

3.2 Design Principles

In graphics in general there are some basic design principles which can be relevant to infovis but only in service to the information's purpose. Quoting straight from Wikipedia [online, 70], these include:

1. unity
2. harmony
3. contrast
4. repetition (rhythm, pattern)
5. variety (alternation)
6. emphasis
7. balance
8. proportion (scale)
9. functionality
10. proximity (similar object closer)
11. decluttering, organization, harmonization
12. lighting & color

Specifically in information visualization, there are some generally held ideals of good design which transcend computers or other tools and are relevant in any information graphic. Because infovis serves to build understanding, these ideals also serve to improve thinking. As Tufte says, "The principles of analytical design are derived from the principles of analytical thinking" [26].

These basic infovis design principles include:

1. show contrasts and comparisons
2. show causality and explanation
3. show more than 1 or 2 variables
4. clearly include words, numbers, labels, with images or diagrams

5. document: source, creator, credentials, title, date, scales, and any relevant issues
6. content counts: quality, relevance, integrity

As Tufte explains, these principles are based on very fundamental ways of thinking and provide for communication, therefore they apply to both producers and consumers of infovis [26].

3.3 Design Choices

Other elements can be considered design choices, like "overview first, zoom and filter, details on demand", as Wattenberg and Kriss chose to do when creating the successful website, NameVoyager, which used these design suggestions from Schneiderman [33]. Another design choice they made that dramatically impacts the user's experience is to have the search results return on every keystroke of the user without waiting for the user to click enter. This increased exploration and serendipitous excitement when users saw unexpected results [33].

Design goals for casual infovis should not need to adhere to the utilitarian, but can aspire to be "pleasing" and to respect and satisfy the ethnographic needs of the individual public users. There is room for ambiguous depictions of data in casual infovis which is in stark contrast to the needs of traditional infovis for strict clarity [20].

There is an element of fashion in design, some things are catchy and pleasing today, out of style and uninteresting tomorrow. A popular and fashionable design decision might help capture the consumer's attention, thus promoting insight from data if the visualization also satisfies the many other attributes of valuable casual infovis.

3.4 Objective or Subjective

As Van Wijk explains, the infovis ideal is objective extraction of knowledge from data, but this is often subject to the viewer's knowledge, the parameters of the visualization such as changes in scale, and selections of data. Changing the infovis conditions can expose patterns and the way data is manipulated effects its validity as repeatable science [27]. One example is Van Wijk's own visualization of wave surfaces, shown in Figure 5, that used commonly applied but incorrect interpolation: bilinear interpolation in the top image (wrong results), cubic interpolation in the middle image (still wrong), and cubic approximation in the bottom image (correct) .
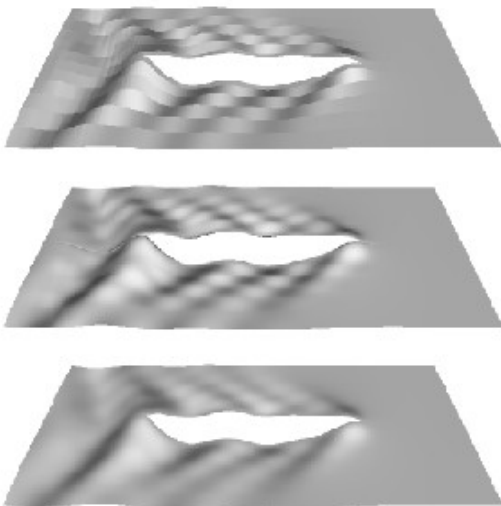

Fig. 5. Van Wijk, wave interpolations affect results [27]

3.5 Interaction or not

Non-expert users might assume interactivity would be crucial, but there are two types. One interactivity effects production and changes the data and requires recalculating and formulating the infovis. Another interactivity impacts post production viewing only, such as focusing in, or using sliders to filter or clarify.

With production related interactivity, Van Wijk suggests careful limits so the user doesn't make the infovis subjective instead of objective by demanding nonsensical parameters and receiving erroneous results. There is a distinct cost to re-calculate and re-render an infovis as well as the user's time to set parameters if there many options. Good default presets aid clear usability in this case [27].

Post production interactivity is not always helpful, depending on the purpose. Marketing, seeking funding, or evidence presentations usually benefit from interactivity. Visualizing facts can be very convincing to a customer and adding interactivity in the review can yield stronger evidence.

Some infovis must to be interactive. Two examples are exploration infovis and social goals infovis.

3.6 Requirements: Functional, Physical, Qualitative

Requirements are fundamental conditions that must be met. Considering the wide range of purposes of casual infovis, some of the following requirements are more and less applicable.

There some basic functional requirements [9] that make an infovis tool more adoptable:
1. offering different views
2. abstraction to simplify complexity
3. offering search
4. code proximity (access to original data)
5. automatic layouts (good starting point or better)
6. undo and history (interactive manipulation control)
7. filtering and grouping [19]

A few basic physical requirements that must be met before infovis products can achieve commercial success [19] include:
1. making infovis lightweight enough to run on a general user's computer without plugins, delays, network issues, or other problems
2. making it easy to import data or deal with incomplete data
3. helping users integrate with other applications
4. helping users collaborate with others

Besides physical requirements, Kienle recommends qualitative requirements [9] :
1. rendering scalability - performance speed
2. information scalability - just information of interest
3. interoperability of tools or code segments, reusable
4. customizability
5. interactivity - manipulate as well as navigate
6. ease of usability
7. adoptability – adaptability to user's task

3.7 Individual and Social Aspects

There are many individual and social aspects to consider when valuing casual infovis. For example, individual perception and interaction illustrate usability but also influence successful data understanding [25].

Work done for human computer interaction (HCI) can be applied in some ways to human factors in visualization, such as reducing navigation, developing tools that provide support for organization, perception, and cognition, and doing user studies and comparing infovis techniques [25].

Other individual aspects include universal usability and learnability issues such as considering color blindness and other

impaired users, having layers of complexity to fit users understanding, and offering color palette choices or sonification of graphs to make infovis tools accessible [19].

Social aspects that build interest and value in non-expert infovis include finding oneself, building community, being part of something, collaborating, being stimulated, as well as the very human element of competition. Early adopters of casual infovis can be categorized as gamer types in Bartle's taxonomy. This includes "achievers, socializers, killers, and explorers" [33].

The social aspect of finding oneself or other recognizable people in a visualization proved a strong attractor to visitors to the public installation of "Artifacts of the Presence Era", which is a sedimentary layering of surveillance of museum visitors over time, shown in Figure 4 [29].

Exploration and analysis can be independent but one successful repercussion could be creating an online social environment where people get together to analyze data together [33]. InfoVis users become more than consumers, but instead collaborators in spreading understanding. Jenkins describes a *participatory culture* which includes "low barriers...and strong support for creating and sharing" [30].

NameVoyager [online, 71] succeeded in getting and keeping the public's attention by making their application easily available on line, having an easy comment section for conversation, and a design aesthetic that was "cool" and fashionable. Comments on the website led to conversations, challenges, guidance, and inspiration. The NameVoyager creators also hypothesize three other factors for holding the public's attention: 1) having common ground but room for individual opinion; 2) a comfortable spectator experience so groups work together on one machine making it more social; 3) ease of sharing interesting findings and repeatability, so other explorers can do the same, and allowing comments in the conversation [33].

Wordle's popularity can also be credited to users creating for themselves [online, 52], interacting with messages, and sharing their creations. Users report that their attraction is based on having self expression choices, using words they choose and having creative design choices. Wordle succeeds against the conventional infovis principles of clarity and simplicity. It could be argued that Wordle is not an information visualization because users don't bother understanding the analysis of the data behind the pretty decoration of Wordle results [30].

Early adopters are visionaries, but making the leap to the early majority requires having the tools satisfy the user's needs for something that practically and reliably solves some problem, thus fulfilling some utilitarian need [19].

3.8   Meeting the Purpose

One basic assessment of the value of infovis is whether the results accomplish the purpose. But the purpose in casual infovis could be almost anything; subjective, individual, objective, or institutionalized. Pousman raises the question, if insight is less analytical, then do the infovis tools or goals need to be adjusted? [20]

Different purposes are differently measurable in achieving their purpose. As Van Wijk points out, a technology purpose can be evaluated by its effectiveness and efficiency whereas an art purpose is very subjective and a science purpose requires satisfaction of fundamental theories. Understanding of the methods for gaining insight can be used to evaluate infovis [27].

If a casual infovis is intended to amplify cognition, then a "sensemaking" model might be helpful to use. Yi explains that gaining insight and sensemaking are iterative and involve two cycles: elaborating a frame and then reframing [36]. Other visualization researchers recommend providing an overview, adjusting by grouping and filtering, detecting a pattern including

outliers and the unexpected, then raising new questions and hypotheses to match the mental model [36].

Sometimes insight can be gained by a small number of users and still have a major impact, for example the historic cholera map in England in the 19th century [27].

A user's background knowledge and interests can impact the effectiveness of achieving the purpose of the infovis. If the user is already primed for insight, their engagement in interactive systems may be very efficient. Or there could be barriers to insight, not just the user's lack of experience or training, but also infovis problems like occlusion, shading, clutter, and usability problems [27].

Sometimes a visualization fulfills its purpose very well, but is not a publicly available tool. For example, themail [online, 60], a project that visualized an individual's email archives and gave "haystack" and "needle" exploration modes to see trends, keywords, and the evolution of relationships over time, was enthusiastically greeted by its test audience of only 16 people. Users wanted to continue to use themail and share it with friends, but themail was only an experiment in the M.I.T. Media Lab [31].

Sometimes an infovis fulfills a purpose that is opposite to the dispassionate analysis goals of pragmatic infovis. There are a number of artistic information visualizations that demonstrate the power of a strong point of view to achieve a purpose of influencing and drawing in the viewer. These artworks emphasize distortion and thus are opposite from traditional infovis with it's value of neutral point of view and clarity, for example "Last Clock" [28] shown in Figure 6.

South Kensington, London   BBC 2, Golf   Big Brother, Channel 4

Fig. 6. "Last Clock": video surveillance in public area capturing time and motion and mapping seconds, minutes, hours, completely non-utilitarian, intended as art [28]

3.9   Measure Value

There are many attributes that can lead to high value, but how to evaluate these attributes? And with casual infovis having such broad intentions, how to measure if they fit their purpose? Appraising value can lead to improvements in producing and using infovis tools in all areas of infovis [20]. But it can be argued that insight and knowledge can not be measured [27].

One challenge of evaluating casual infovis is deciding exactly what to measure since casual infovis is not necessarily productivity oriented or limited to lab use where things can be measured. There is also the question of how to gauge non-analytical insight. Evaluation methods can borrow from the generalized techniques of traditional infovis evaluation and also from the HCI research area [20].

At the engineering end of casual infovis, VanWijk's work quantifies value through the economic model of cost/benefit analysis and the engineering model of efficiency and effectiveness. Decision making help is the goal of visualization and it is important to look for actions that can be taken after reviewing the visualization [27], similar to efficiency models for business and education, which have actionable outcomes.

New methods or purposes for visualizing should actually be better, not just new. They need to have advantages and no limitations. Combining conventional ways with new visualizations can yield quick readability, effectiveness, and

straightforward information. But the end user is a subjective factor in the effectiveness of any measurement or evaluation, including the user's perceptual abilities, how much the user values insight, their knowledge of the data, and how much time and money they're willing to spend [27].

Evaluating information visualizations requires a vocabulary and theoretical framework to do visualization criticism. This is similar to the field of art needing art criticism for evaluation and to keep art vibrant. Visualization criticism can develop a vocabulary, theory, principles, and guidelines for reviewing infovis and address the commonly ignored aesthetic questions [12].

Infovis criticism could address interdisciplinary issues that are both pragmatic design problems and aesthetic questions. For example:

> "How do we attach meaning to graphical objects? How should we represent different kinds of data to make them easier to understand? What role do metaphors play, and how can they be used?" [12]

Evaluating visualization with criticism can begin with some expected practices:

1. maintain a neutral voice
2. back up any statements with facts
3. exclude any self promotion
4. give alternative solutions when criticizing

And end by developing broadly applicable criticism principles and guidelines for producers of visualizations to use [12].

Judging the value of artistic infovis requires considering important aesthetic expectations, which can be subjective. Some expect to find the enigmatic or the sublime, that which inspires awe or emotions, and captures the viewer's interest or possibly communicates a concern or problem not understood until it is visualized. The sublime can be in stark contrast to user friendliness and clarity of understanding that is usually expected from more traditional infovis [12].

In the case of ambient infovis, evaluation can be based on whether the public comprehend that the graphic is representing data, what that data is, and can they read it for the information it intends to convey. Selecting the type of data to present in an ambient infovis is very important because it provides information to people who may not have been seeking information. For this reason, the data needs to be relevant and appropriately updating [22].

Ambient infovis based on an artistic style could still be readable and convey information. Researchers found that sometimes applying an artistic style increased viewer's understanding by forcing the infovis designers to keep variables simple. In the case of the bus schedule shown in Figure 1, adding a relevant geographic mapping component to the abstract artistic ambient infovis made it more readable [22].

Measuring the value of subjective, non utilitarian casual infovis requires development of a infovis criticism field, and more objective casual infovis can be valued by many attributes and whether it successfully achieved its purpose.

3.10 Selected Examples

Many Eyes website is a great example of casual infovis [online, 44]. It offers data, ready to go, it offers a way to add your own data, it offers many ways to visualize the data and some tutorials on how to do it, including interactive help. The three requirements of Viegas's theme to popularize infovis are met at Many Eyes; crowds can create, view, and discuss all in one with no personal resources spent except time [30].

But Many Eyes is still not very easy to use or understand. I was frustrated after about 90 seconds. I wanted to visualize the bathroom graffiti but the result I ended up with did not seem like it was even related to the dataset I'd selected, it looked like I somehow had some other sample visualization.

And to further support that casual datavis is not ready for prime time, the Many Eyes site is the gold standard of getting infovis out to the public and trying to create early adopters and it doesn't even have it's own web address? Many Eyes web address begins with an alphanumeric code and has five slash stops to get to Many Eyes, as shown in Figure 7. Who's going to bother? Users expect to be able to just type in "manyeyes.com"? Where would Google, Facebook, or CNN be if they didn't have quick to type and intuitive addresses? There can not be ANY extra steps to reach a tool or site if you want the public to bother.

http://www-958.ibm.com/software/data/cognos/manyeyes/
              1   2   3   4   5!!

Fig. 7. Indirect web address for reputable casual infovis website Many Eyes, a disappointment of usability [online, 44]

There are some existing rise and fall examples of attempts to mainstream and commercialize publicly available online infovis tools. One is the website swivel.com [online, 43] and another is verifiable.com [10], both recently "closed" in Summer 2010. In answer to the question, "Is there a need for public infovis?", Brent Fitzgerald, formerly of Swivel, answers,

> "I guess one of my Swivel takeaways is that visualizations are tools or lenses, and people will create visualizations out of need, in the contexts in which they are needed. It's easier to start with the problem, then solve it, than the other way around." [11]

Another example takes casual infovis as a "amplifier of cognition" to the level where information is power and can be used to eradicate poverty. Anne Chappuis, a French woman working in India, started a non governmental organization called Visual Information Systems for Action (VIStA) [online, 45]. Chappuis says,

> "We believe that the villagers, even if illiterate, are clever and capable of analyzing their situation and planning for their future if they are provided with information, and specially with visual information." [6]

Over the years she has relied heavily of visual analysis tools to support many organizations in France and India, believing that information is an asset for development and sharing information and working in partnership help the rural poor access a broad range of services and enhance business intelligence capabilities in agriculture, rural livelihoods, marketing, microfinance, and general well being, as well as facilitating informed decision making [online, 45].

There are some excellent, easy to understand and use, casual infovis for the public that satisfy many of the criteria for good value, for example gapminder.org [online, 40] or vizlab.nytimes.com [online, 63]. Gapminder has interactivity that is completely intuitive, clear layers of quick access, lots of data already arranged to educate, resources for teachers, for kids, and even downloadable card games to help get the user away from being online all the time and to encourage interacting with other humans while learning from datavis. Good HCI and decent design principles make gapminder a very strong infovis tool, although not very "sexy". Gapminder trades visual punch and fashion for utilitarian navigability.

There are plenty of other examples of casual infovis, some only in the research literature and not publicly available. Publicly available online infographics from journalism and marketing are increasing daily. Sometimes the best practices for documenting

data source and other infovis attributes are not followed. Maybe just as the expert statistical analysis of an infographic might be hidden from the casual user, the data source is also hidden? The public should be able to inspect sources in order to be effective watchdogs of casual infovis. It was difficult to find the data source of an infographic on poverty on the Huffington Post [online, 62].

Infovis for personal information still seems a bit unnecessary, but that could change. One example of the edge of infovis is Nicholas Felton, a designer in NYC, who makes a personal annual report [online, 68]. Clearly he spends part of his time bothering to track his actions. This is pretty extreme navel gazing which he designs into his attractive and innovative report which is of subjective value.

Romero and Mateas want to expose the public to ambient intelligence, not as a spy system but to combine artificial intelligence, HCI, and art considerations into a home infovis called the "Tableaux Machine". The Tableaux Machine provides opportunities for contemplation and wonder through interpreting the activity in the home, observed through cameras and microphones, and adjusting the ambient display to represent the perceived mood using artificial intelligence. They claim the system is a closed loop, perfectly private, and it should be emphasized that, "our emphasis is not on centralized surveillance, but on auto-surveillance" [21].

Data mining can be used to create casual infovis, for example "wefeelfine.org" [online, 54] mines the web for the words "I feel" and then catalogs the weather, location, and age of the author, and files it in a database. The goal: "We hope it makes the world seem a little smaller, and we hope it helps people see beauty in the everyday ups and downs of life." [online, 44]

4 FINDINGS

Casual infovis and edge case explorations hope to encourage the non-expert public to be both users and creators, and this accessibility provides opportunity and innovation, but casual infovis has not yet arrived in the mainstream.

The value or casual infovis includes serving a purpose, solving a problem, being usable and accessible, as well as providing a sublime, enigmatic, or other aesthetic, building community, and many other individual values. It is clear that casual infovis can be personal and subjective to evaluate, just like any other art or entertainment.

There has been no widespread effort to create public demand for infovis tools and there are no clear problems for a personal infovis to solve, thus no incentive for the public to be bothered with individual casual infovis.

There is a faulty assumption that people had large amounts of personal information and data that they might want to visualize or understand better. People would probably like more information about their lives but are unlikely to take the time to do this work for themselves. There are many far more compelling things to do with time. In some cases, service industries have filled some of that need, for example, the bank may provide an end of year visual statistical overview of your spending on a credit card for the year.

Further evidence that casual infovis is not yet mainstream include the recent failures of attempts to commercialize infovis services, such as swivel.com and verifiable.com [11], and the lack of direct web addresses for reputable infovis sites like Many Eyes [online, 44].

4.1 Outlook for Casual Infovis

The outlook for casual infovis is difficult to predict, but the general public will probably be more and more active as producers and consumers of infovis.

Just as with the proliferation of cameras in the hands of non-experts years ago, there is a whole spectrum of people with different attitudes and needs, who could be producers and consumers of casual infovis [6] and the field can be ready with simple and effective tools that meet specific goals with elegance, supporting non-expert users and strengthening visual literacy [2].

The area where infovis continues to be driven by the market is journalism. This is a public area and this is an area that will continue to evolve and thrive and expand, probably very rapidly. One thing that must happen is that the public will need to become literate in reading the infovis. The producers of educational and journalistic infovis must pay attention to educating their users, and they are attending to that task.

Some tips for producing popular casual infovis come from Wordle's good design choices coupled with an "online creative ecosystem" allowing non-expert users to experiment and to export and save their creations, even continuing to work on them in other applications, a full life cycle of fun and sharing [30].

Popularizing casual infovis requires that it is: free, online, easy, effective, allows for sharing and community, has import and export capabilities, hides technical details, and gives the user strong controls over usability.

4.2 Increasing Exposure To Visualization

Increasing the non-expert public user's exposure to casual infovis can include modeling as many forms of infovis as possible and hopefully not stifling their interest or attention, or creating a negative backlash. Some of the vehicles for exposure include:

- blogs
- product marketing
- books and journalism
- "visualati" - distinctive popular individuals from infovis or existing public figures that can shine a light on infovis, e.g. Edward Tufte, Hans Rosling, and Al Gore [6]
- Social or collaborative visualizations
- ambient intelligence and data mining infovis, e.g. "Tableaux Machine" [online, 59] or wefeelfine.org [online, 54]
- information is power: infovis used to eradicate poverty, e.g. Visual Information Systems for Action [online, 45]

Viegas hopes that exposure, the ability to create, view, upload their own data, and communicate about it will help popularize casual info vis, but another benefit of a site like Many Eyes [online, 44] is that developers and designers can gain exposure for their infovis tool inventions and test them through public experimentation at Many Eyes [32].

Another active effort to expose the public to more infovis includes the work of Chappuis in trying to eradicate poverty by exposing Indian villagers to information visualizations [online, 45].

4.3 Concerns

One concern as infovis moves into the hands of the public, to create and innovate on their own, is that data manipulation and selection can be easily abused. But just as a photograph now has little meaning as an evidence object because of the proliferation of public use photo manipulation tools, infovis viewers need to remember that information can be manipulated.

The public will need educating to understand that infovis can be false. Critical thinking and viewer beware, as with anything. The public can provide a many-eyes-watching method of healthy checks and balances on infovis legitimacy.

The topic of exposure makes one wonder about privacy issues, especially when we learn about ambient surveillance, data mining for feelings, and graphing relationships.

Casual infovis in the hands of the internet public is a topic that is built on a foundation of computer literacy, which can not be assumed. There are many people without the means or the motivation to be online computer users.

So there are resource issues, motivation issues, values issues, and education issues to overcome for the public to be truly comfortable gaining insight from infovis.

Making data and analysis more democratic will expose the public, but even with hiding the statistical details behind a visualization tool, the non-expert user can still create links between data that don't exist. Few recommends that best practices training will help avoid this problem and points to the example of Many Eyes for its good understanding of effective infovis and collaboration [6].

5 CONCLUSION

The public is probably going to be using, and possibly abusing, casual infovis for many purposes of self and group education, enjoyment, enrichment and insight. Information visualizations are a very powerful tool: rapidly understood, influential, and potentially spreading knowledge to the masses. So many facets of life could be changed by the decision making help and other skill adaptations that information visualizations offer. On the other hand, people are skeptical and wary. Maybe visualizations will just be organizational, a fad, a marketing tool, or limited to specific users.

Casual infovis is growing and evolving and has the potential to be very valuable. Interesting innovation abounds on the edges of infovis for both presentation and exploration. Many factors play a role in establishing a visualization's value depending on it's purpose. When casual infovis solves a problem that is common for the public, it will probably become a popular element of the mainstream.

Making infovis capabilities available to non-experts is a great opportunity for innovation, insight, appropriate critical thinking, and hopefully watchdog skepticism will emerge to match the growth of casual infovis. Let's advocate for non-expert, casual, public, infovis exploration and usage.

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