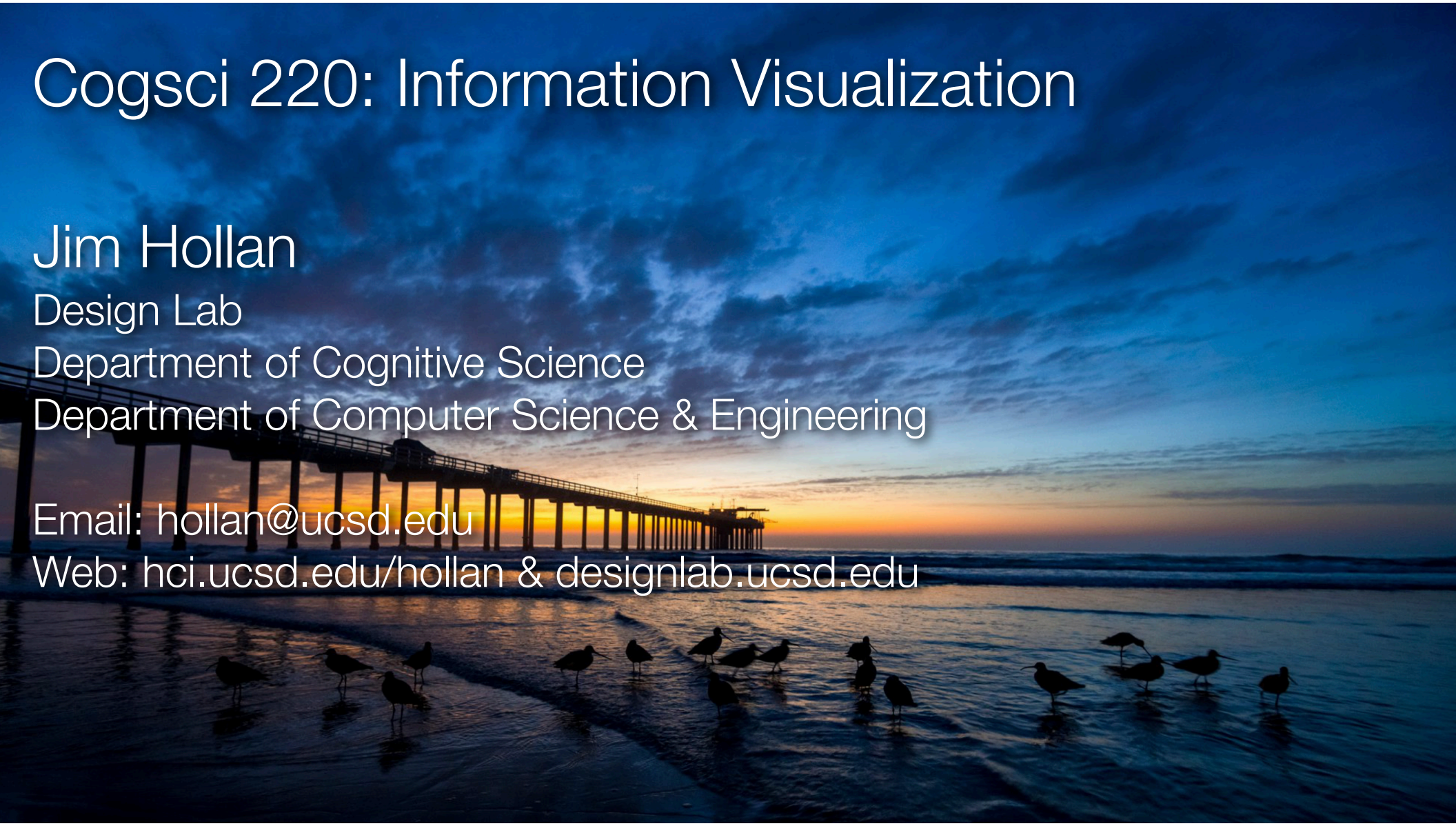

Cogsci 220: Information Visualization

Jim Hollan
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Department of Computer Science & Engineering

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Cogsci 220: Information Visualization

Welcome to the second week.

We must continue to acknowledge that this is an incredibly challenging, uncertain, and deeply troubling time. This impacts the course and all of us.

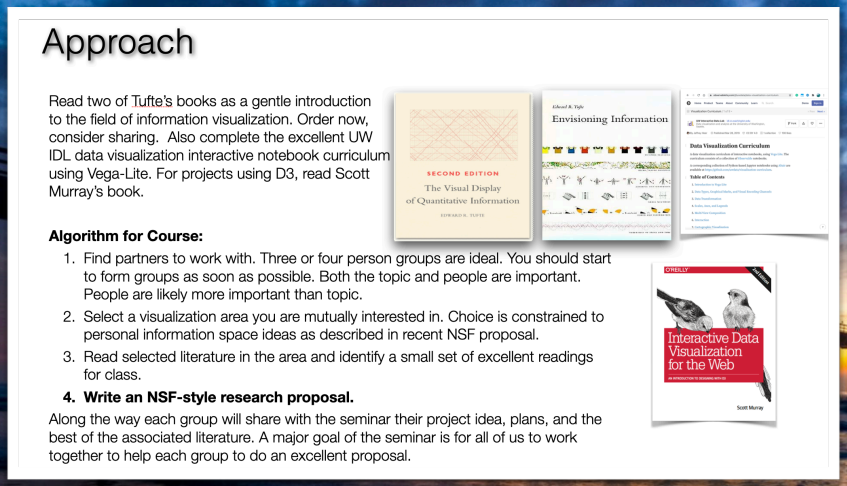
In addition to the continuing and intensifying global pandemic, last Wednesday we witnessed an insurrection, the breeching of the Capitol by a violent mob encited by Trump.

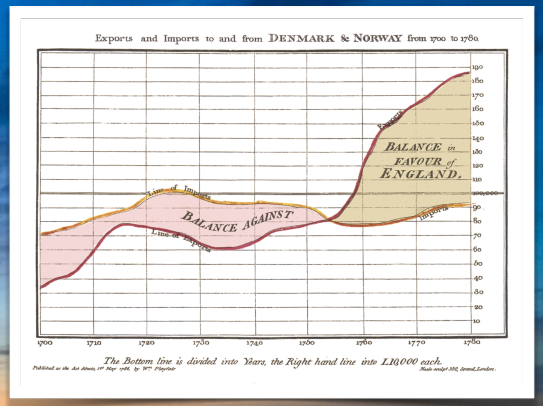
I am sure you were profoundly saddened by these events and like me could do little but remain glued to coverage and the subsequent analysis.

My continuing hope is the course can be a bit of a respite, an opportunity to think about research ideas, be creative, and develop visualization skills.

Cogsci 220: Information Visualization

Last week I gave some advice for grad students, provided an overview of the course, and discussed the beginnings of statistical graphics with William Playfield in the late 18th century.

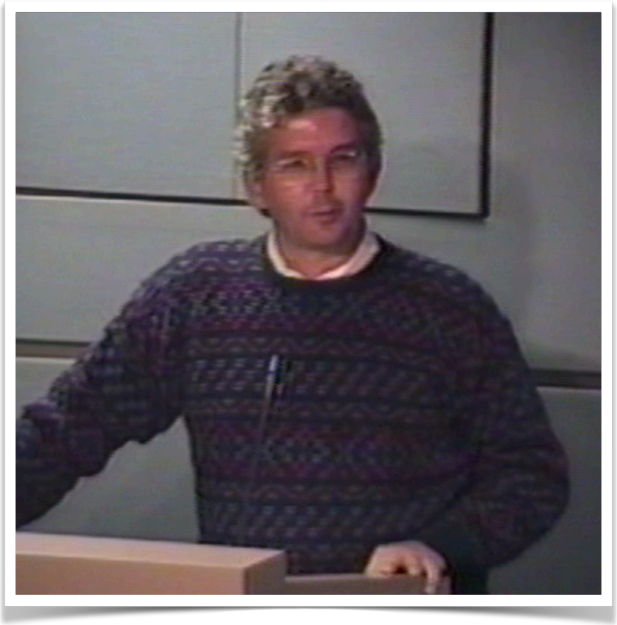




I ended with pointing you to a video about Vega-Lite. The week 1 video is on website

There are assigned readings in the two Tufte books starting in week 3.

Tufte Talk



Cogsci 220: Information Visualization

Today I want to accomplish three things

1. Make an argument for the importance of visualization
2. Discuss the required readings from last week
3. Try an experiment to help people get to know each other a bit better

I expect your week was interrupted by the events of last Wednesday too. We will postpone going over initial selection of general topic choices. Only 6 people had filled out the form as of yesterday evening.


CHS: Medium: A Human-Centered Information Space:
Designing Dynamic Personalized Visual Information

Amy Rae Fox[1], Arvind Satyanarayan[2], Philip Guo[3], Haijun Xia[4], and James D. Hollan[5]

[1,3,4,5]Design Lab and Department of Cognitive Science, UC San Diego
[2]Visualization Group, Massachusetts Institute of Technology

Overview: The historical moment when a person worked in front of a single computer has passed. Computers are now ubiquitous and embedded in virtually every new device and system, ranging from the omnipresent cellphone to the complex web of sociotechnical systems that envelop every sphere of personal and professional life. They connect our activities to ever-expanding information resources with previously unimaginable computational power. Yet with all the increases in capacity, speed, and connectivity, information-based activities too often remain difficult, awkward, and frustrating. Even after six decades of design evolution there is little of the naturalness and contextual sensitivity required for effective and convivial interaction with computer-mediated information.

The heart of the project is to rethink the nature of computer-mediated information as a basis to fully realize the potential of computers to assist information-based activities. We propose linking the existing information world of documents and applications to a multi-modal virtual workspace in which entities behave in accordance with cognitively-motivated rules of behavior sensitive to the context of activity history. Iterative development and evaluation of a series of prototypes designed to facilitate pervasive information tasks will inform design of dynamic personalized representations and the architecture of a human-centered information space.

Focusing on the domain of data analysis and visualization and the problem of activity fragmentation, this effort will (1) address the challenges of capturing and representing cross-application information activity, (2) design and evaluate activity-centered representations, (3) develop a cognitively-principled grammar of dynamic information behavior, and (4) integrate these features into a prototype information space realized as a web-based JupyterLabe extension to facilitate systematic evaluation in real-world use and encourage widespread adoption.

Intellectual Merit: The intellectual merit of this effort derives from challenging the presupposition that information is passive data, disconnected from processes, tasks, context, and histories. We propose to move beyond this legacy view and the silos of current applications to design, develop, and evaluate information entities that dynamically alter their appearance and behavior in response to task, history, and context. Developing effective principled composable general rules of behavior as the basis for a dynamic visual information space is the primary scientific focus. We refer to the rules as being *cognitively canonical* because they are specifically designed to operate in ways attuned to our perceptual and cognitive abilities.

Broader Impacts: The broader impacts of the proposed activity derive from the potential to radically improve the efficacy of computer-mediated information activities and reshape how we think with computers. In addition to research publication, all software will be open source and made available via a GitHub repository. Educational impact will result from training students in the interdisciplinary approaches required to design a new generation of information environments, providing research opportunities for graduate and undergraduate students. Student exchanges and interaction with collaborating international research labs will enrich student experience. We will continue to participate in UC San Diego outreach programs to engage students from diverse locations, including the innovative on-campus Preuss Charter School for low-income middle and high school students. Beyond publication, education, and outreach, our goal is to seed crystallization of a research community to further develop and evolve this novel approach for designing and interacting with dynamic information.

Keywords: activity history; application silos; cognitive principles and laws of cognition; cognitive tools; co-adaptive systems; distributed cognition; dynamic media; human computer interaction; information visualisation; interruptions; instrumental paradigm; Vega-Lite; Webstrates.


Falling Down the Rabbit Hole:
Exploratory Search and The Case for Personal Information Environments

AMY RAE FOX, ROBERT KAUFMAN, and JAMES D. HOLLAN, University of California, San Diego

Fig. 1. New Yorker columnist Katheryn Schulz writes that, "In its most purely Carrollian sense...to fall down a rabbit hole means to stumble into a bizarre and disorienting alternate reality."[46] [Illustration by anonymized]

Some describe the web-browser as a window onto the world. In practice, it is more often a *rabbit hole* through which we fall. Despite twenty years of research on exploratory search yielding innovative algorithms, visualizations, and domain-specific tools, this pervasive information activity frequently remains frustrating and ineffective. To understand the troubling gap between research effort and user experience, we conducted a six-month participatory design engagement. Through survey, synthesis, activity-recording, and browser-logging, we observed how a common exploratory activity—literature *review*—is distributed through bespoke ecosystems of tools, time, physical and digital spaces. In turn, we offer a conceptual reformulation of "the problem of exploratory search" based on how modern web browsers are used as (impoverished) personal information environments. We contribute a descriptive dataset, restructured problem space, and argument for how understanding the situated context of exploratory search can yield progress on this old but persistent problem.

CCS Concepts: • **Human-centered computing** → *HCI theory, concepts and models*; **Empirical studies in HCI**; • **Information systems** → *Search interfaces.*

Additional Key Words and Phrases: Information Seeking & Search, Tasks/Interruptions/Notification, Information Spaces, Literature Review, Ethnography, Participatory Design

ACM Reference Format:
Amy Rae Fox, Robert Kaufman, and James D. Hollan. 2020. Falling Down the Rabbit Hole: Exploratory Search and The Case for Personal Information Environments. 1, 1 (December 2020), 19 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

Authors' address: Amy Rae Fox; Robert Kaufman; James D. Hollan, University of California, San Diego.

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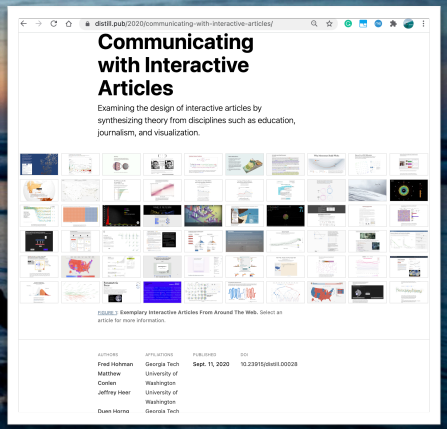
Manuscript submitted to ACM

Manuscript submitted to ACM 1


distill.pub/2020/communicating-with-interactive-articles/

Communicating with Interactive Articles

Examining the design of interactive articles by synthesizing theory from disciplines such as education, journalism, and visualization.

FIGURE 1: **Exemplary Interactive Articles From Around The Web.** Select an article for more information.

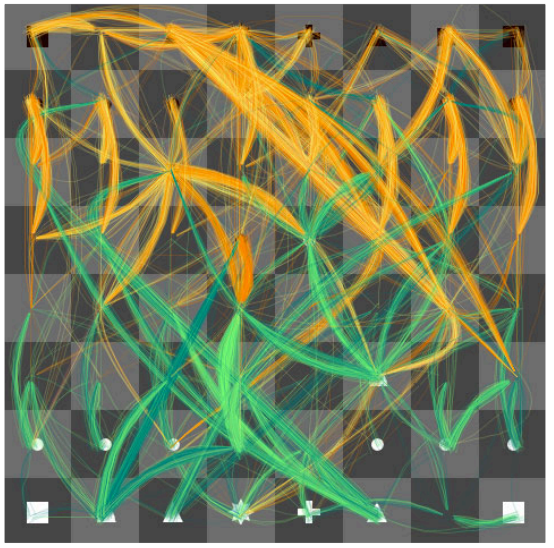
AUTHORS: Fred Hohman, Matthew Conlen, Jeffrey Heer, Duen Horng
AFFILIATIONS: Georgia Tech, University of Washington, University of Washington, Georgia Tech
PUBLISHED: Sept. 11, 2020
DOI: 10.23915/distill.00028

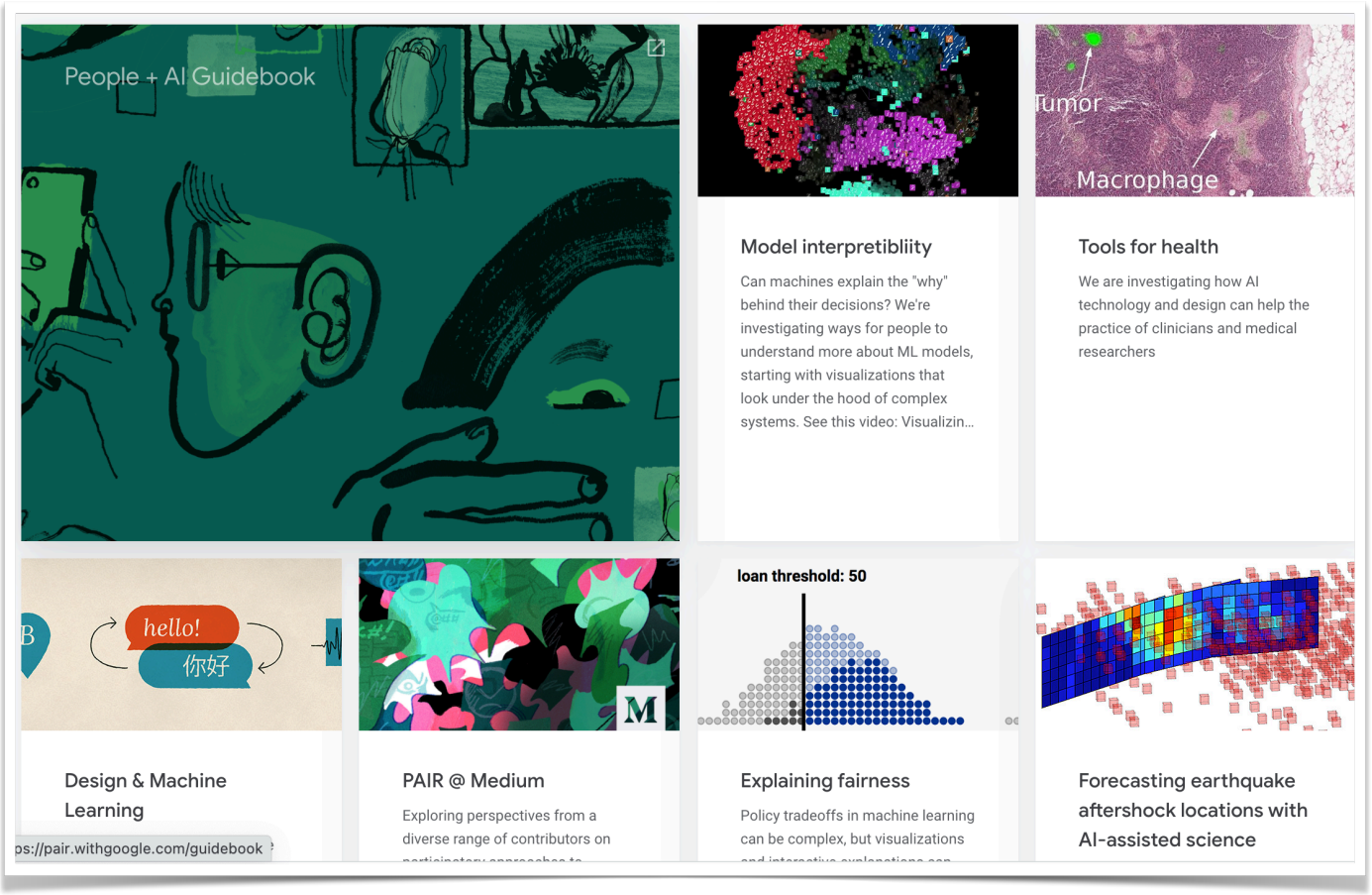
Researchers of the week: Martin Wattenburg & Fernanda Viégas

Co-lead Google's PAIR (People+AI Research) initiative @GoogleBrain. Both joining Harvard this year.

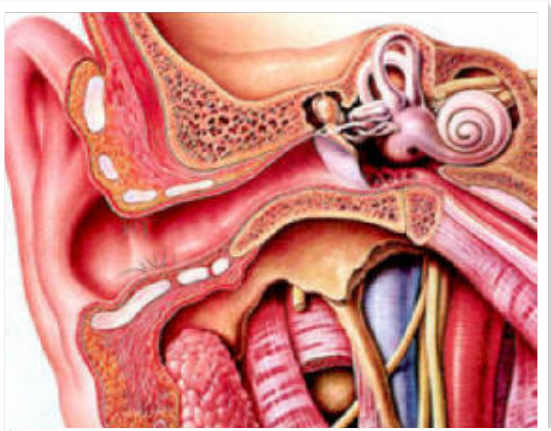
Viégas and Wattenberg came to visualization by separate paths. Her initial training was in design, and his was in mathematics and computer science. They joined forces in 2003 and began exploring the possibilities of visualization as a medium. Before joining Google, he and Viégas founded Flowing Media, Inc., a visualization studio focused on media and consumer-oriented projects. Prior to Flowing Media, they led IBM’s Visual Communication Lab, where they created the ground-breaking public visualization platform Many Eyes.

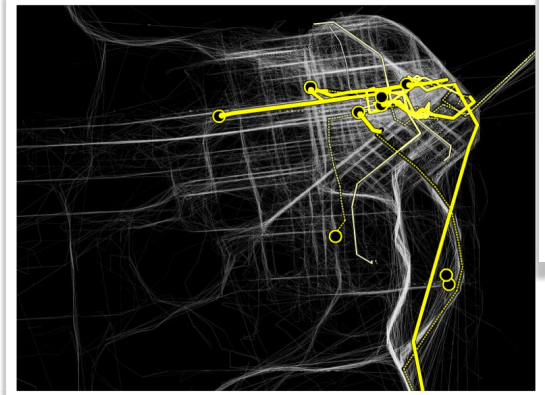
Martin Wattenburg & Fernanda Viégas





What is visualization?





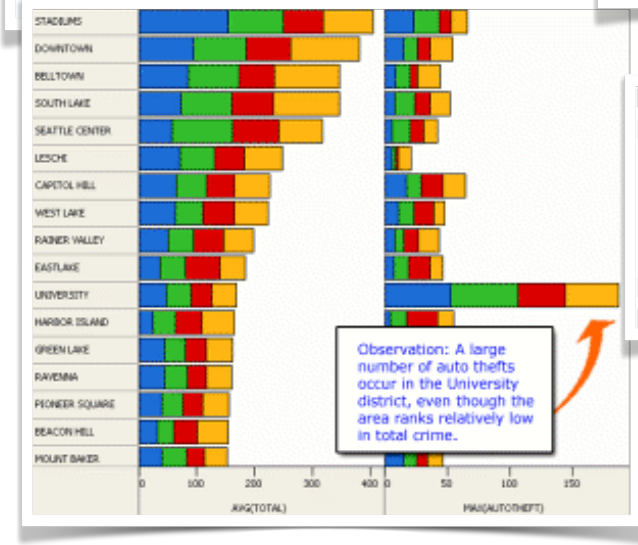
VARIANCE FORMULA

The variance formula includes the Summation Notation, $\sum$ which represents the sum of all the items to the right of Sigma.

$$\sigma^2 = \frac{\sum(x-\bar{X})^2}{N} \qquad s^2 = \frac{\sum(x-\bar{X})^2}{n-1}$$

For population variance

Mean is represented by μ & number of items.



Helvetica Neue 25 Ultra Light
Helvetica Neue 35 Thin
Helvetica Neue 45 Light
Helvetica Neue 55 Roman
Helvetica Neue 65 Medium
Helvetica Neue 75 Bold
Helvetica Neue 85 Heavy
Helvetica Neue 95 Black

What is a visualization?

Definition [www.oed.com]

1. The action or fact of visualizing; the power or process of forming a mental picture or vision of something not actually present to the sight; a picture thus formed.

2. The action or process of rendering visible.

What is a visualization?

“Transformation of the symbolic into the geometric” [McCormick et al. 1987]

“... finding the artificial memory that best supports our natural means of perception.” [Bertin 1967]

“The use of computer-generated, interactive, visual representations of data to amplify cognition.”

[Card, Mackinlay, & Shneiderman 1999]

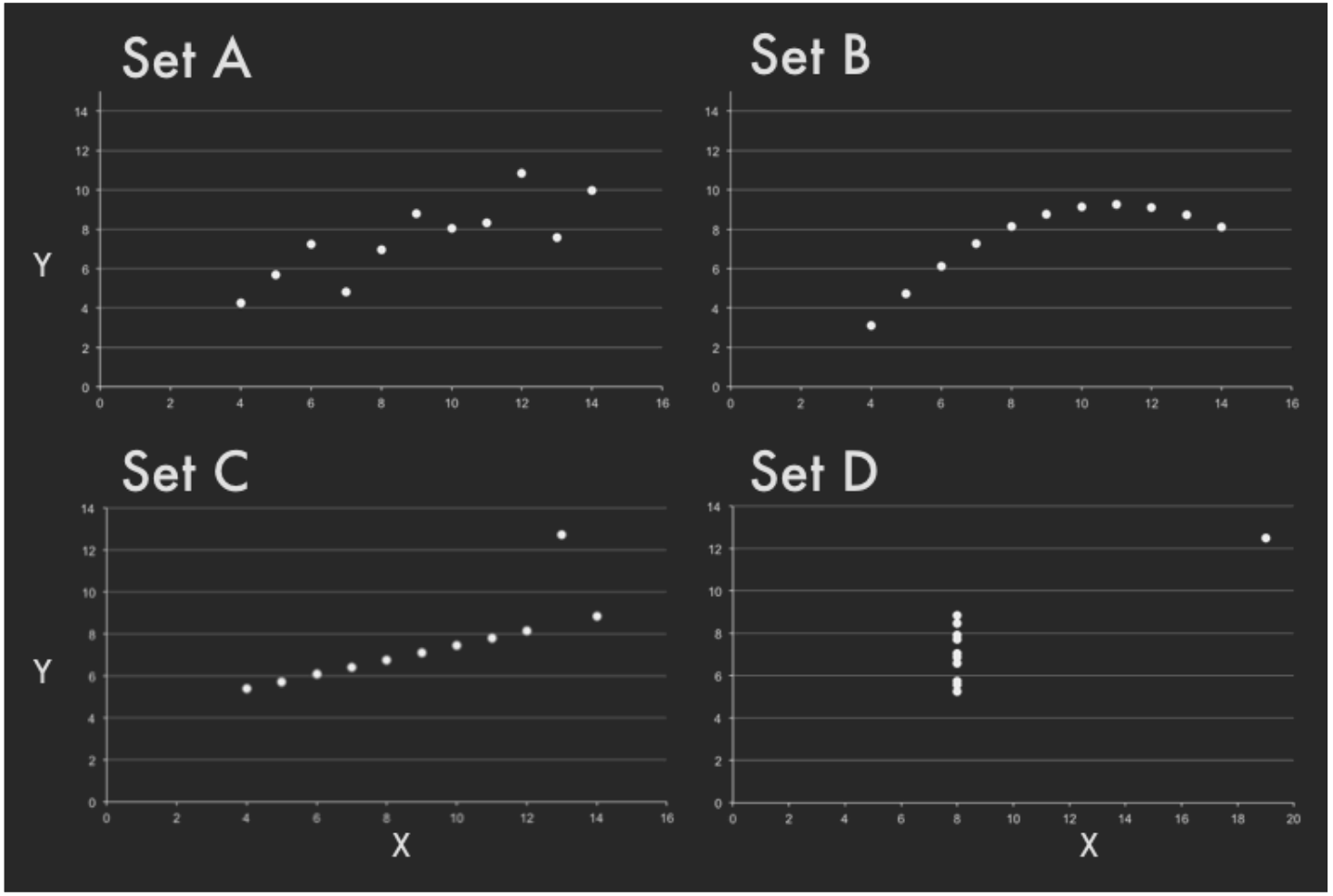
Set A		Set B		Set C		Set D	
X	Y	X	Y	X	Y	X	Y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	19	12.5
12	10.84	12	9.11	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89

Summary StatisticsLinear Regression

$u_X = 9.0$ $\sigma_X = 3.317$ $Y = 3 + 0.5\ X$

$u_Y = 7.5\sigma_Y = 2.03$ $R^2 = 0.67$

[Anscombe 73]


Set A
Y
Set B
Set C
Y
X
Set D
X

Functions of visualizations

“Making the invisible visible and the abstract concrete.”

Record information (photographs, graphs, maps, …)

Support reasoning about information (process, calculate, reason, feedback, interaction)

Convey information to others (present, share and persuade, collaborate and revise, emphasize important aspects of data)


CNN
LIVE
Kennedy Space Center

Challenger 1986

HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

	SRM No.	Cross Sectional View: Erosion Depth (in.)	Cross Sectional View: Perimeter Affected (deg)	Cross Sectional View: Nominal Dia. (in.)	Top View: Length Of Max Erosion (in.)	Top View: Total Heat Affected Length (in.)	Clocking Location (deg)
61A LH Center Field**	22A	None	None	0.280	None	None	36°--66°
61A LH ~~CENTER~~ FIELD**	22A	NONE	NONE	0.280	NONE	NONE	338°-18°
51C LH Forward Field**	15A	0.010	154.0	0.280	4.25	5.25	163
51C RH Center Field (prim)***	15B	0.038	130.0	0.280	12.50	58.75	354
51C RH Center Field (sec)***	15B	None	45.0	0.280	None	29.50	354
41D RH Forward Field	13B	0.028	110.0	0.280	3.00	None	275
41C LH Aft Field*	11A	None	None	0.280	None	None	--
41B LH Forward Field	10A	0.040	217.0	0.280	3.00	14.50	351
STS-2 RH Aft Field	2B	0.053	116.0	0.280	--	--	90

*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.
**Soot behind primary O-ring.
***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

Blow By History

SRM-15 worst Blow-By
- 2 case joints (80°), (110°) arc
- much worse visually than SRM-22

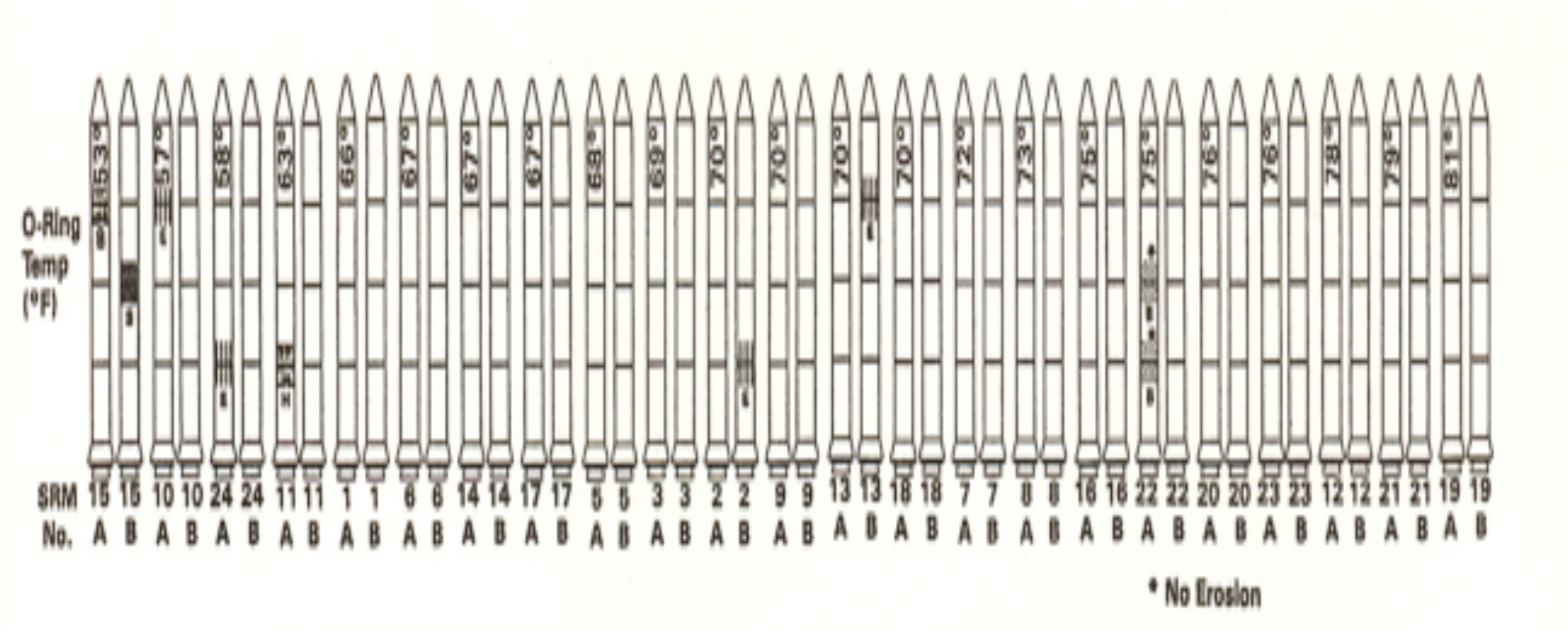
SRM 22 Blow-By
- 2 case joints (30-40°)

SRM-13A, 15, 16A, 18, 23A 24A
- nozzle Blow-By

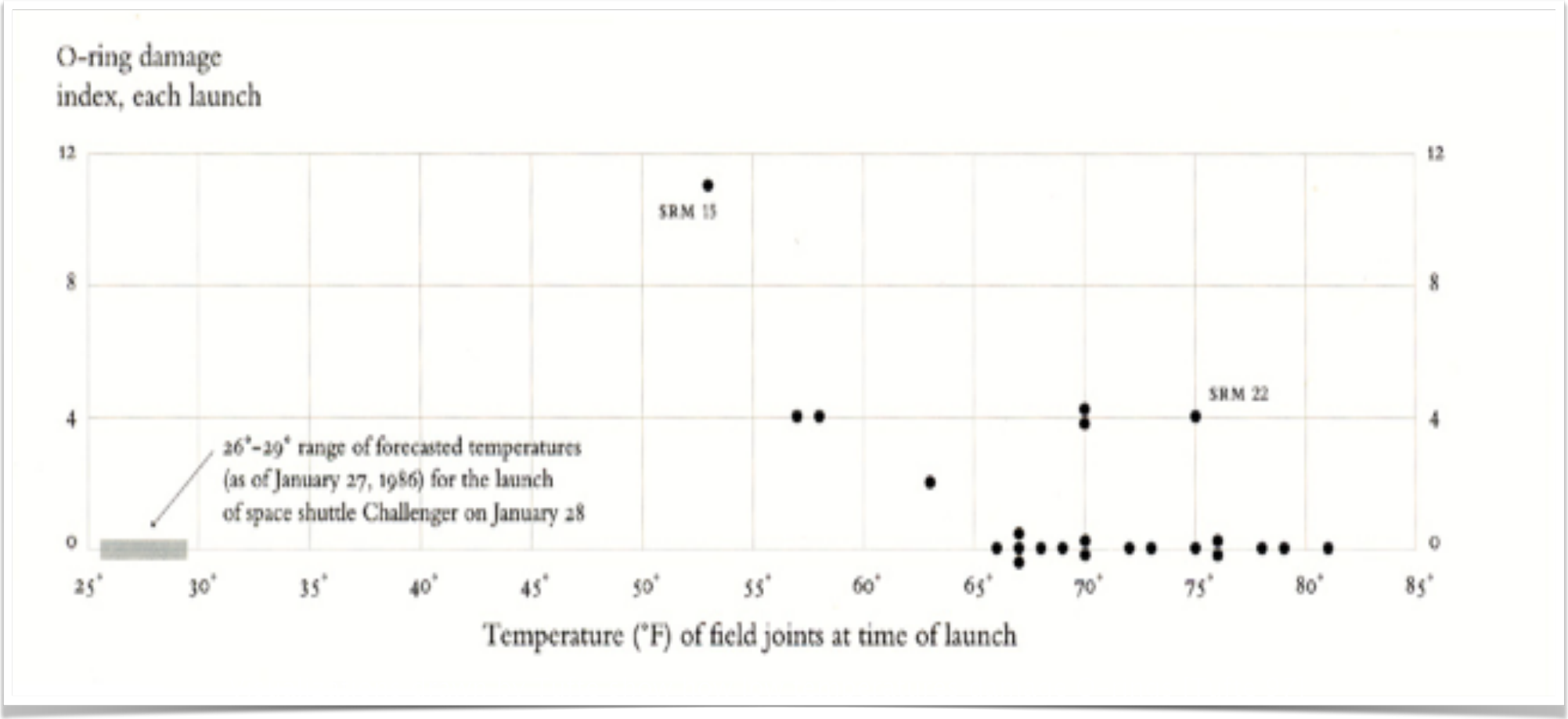
HISTORY OF O-RING TEMPERATURES (DEGREES - F)

MOTOR	MBT	AMB	O-RING	WIND
DM-1	68	36	47	10 MPH
DM-2	76	45	52	10 MPH
QM-3	72.5	40	48	10 MPH
QM-4	76	48	51	10 MPH
SRM-15	52	64	53	10 MPH
SRM-22	77	78	75	10 MPH
SRM-25	55	26	29 27	10 MPH 25 MPH

Make a decision: Challenger



Make a decision: Challenger



Why do we create visualizations?

Find relationships and patterns

Detect outliers

Answer questions

Frame a narrative

Communicate or show information

Engage a viewer (interactivity)

Draw attention
Present argument
Persuade

Make information easier/faster to grasp

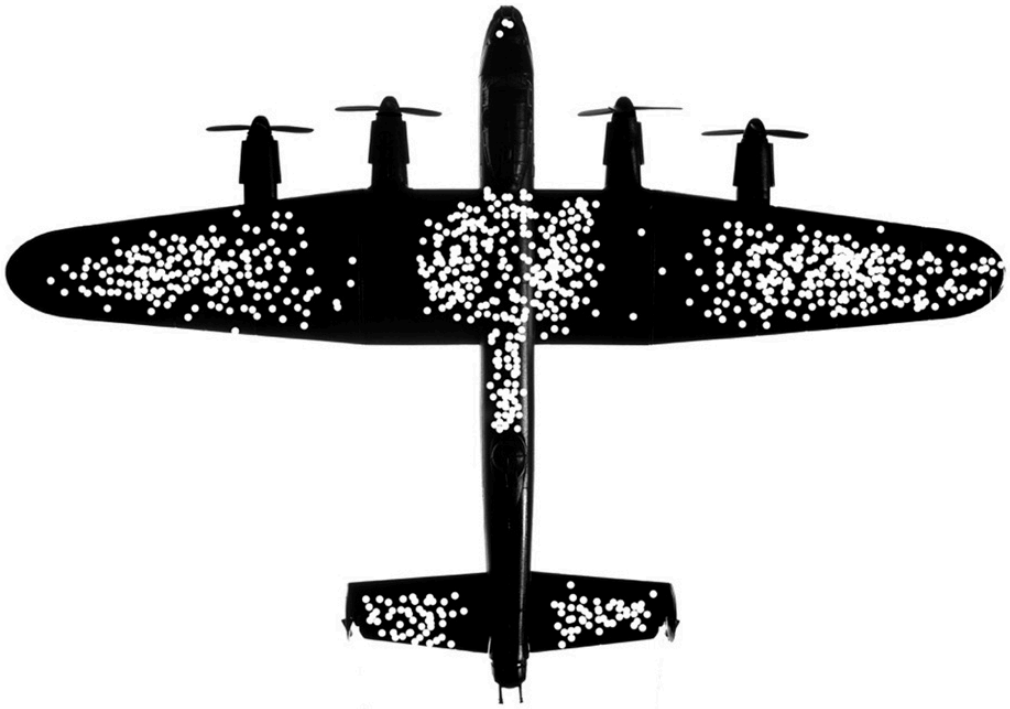
Condense or summarize information

Provide a point of view

Make decisions

Inspire

…

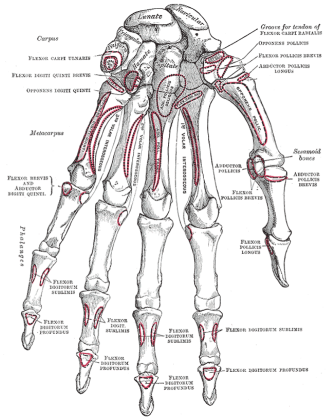


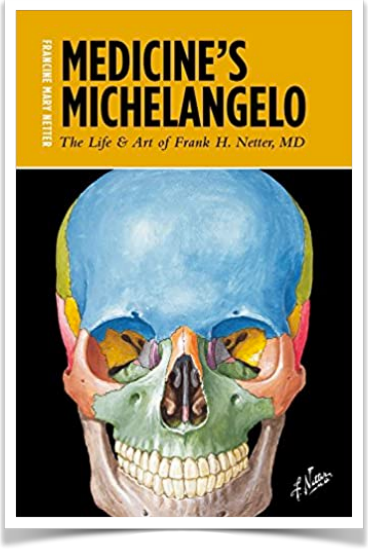
During World War II, researchers at the Center for Naval Analysis faced a critical problem. Many bombers were getting shot down on runs over Germany. The naval researchers knew they needed hard data to solve this problem and went to work. After each mission, the bullet holes and damage from each returning bomber was painstakingly reviewed and recorded.

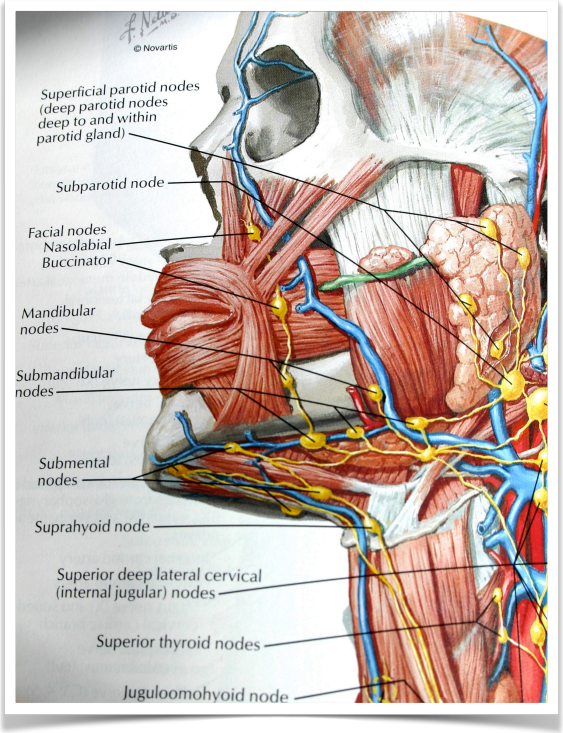
Data in context: Cholera outbreak

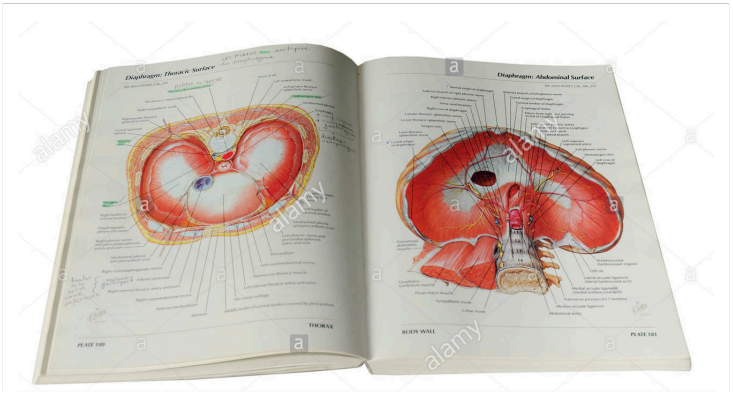
Data in context: Cholera outbreak

Inspire





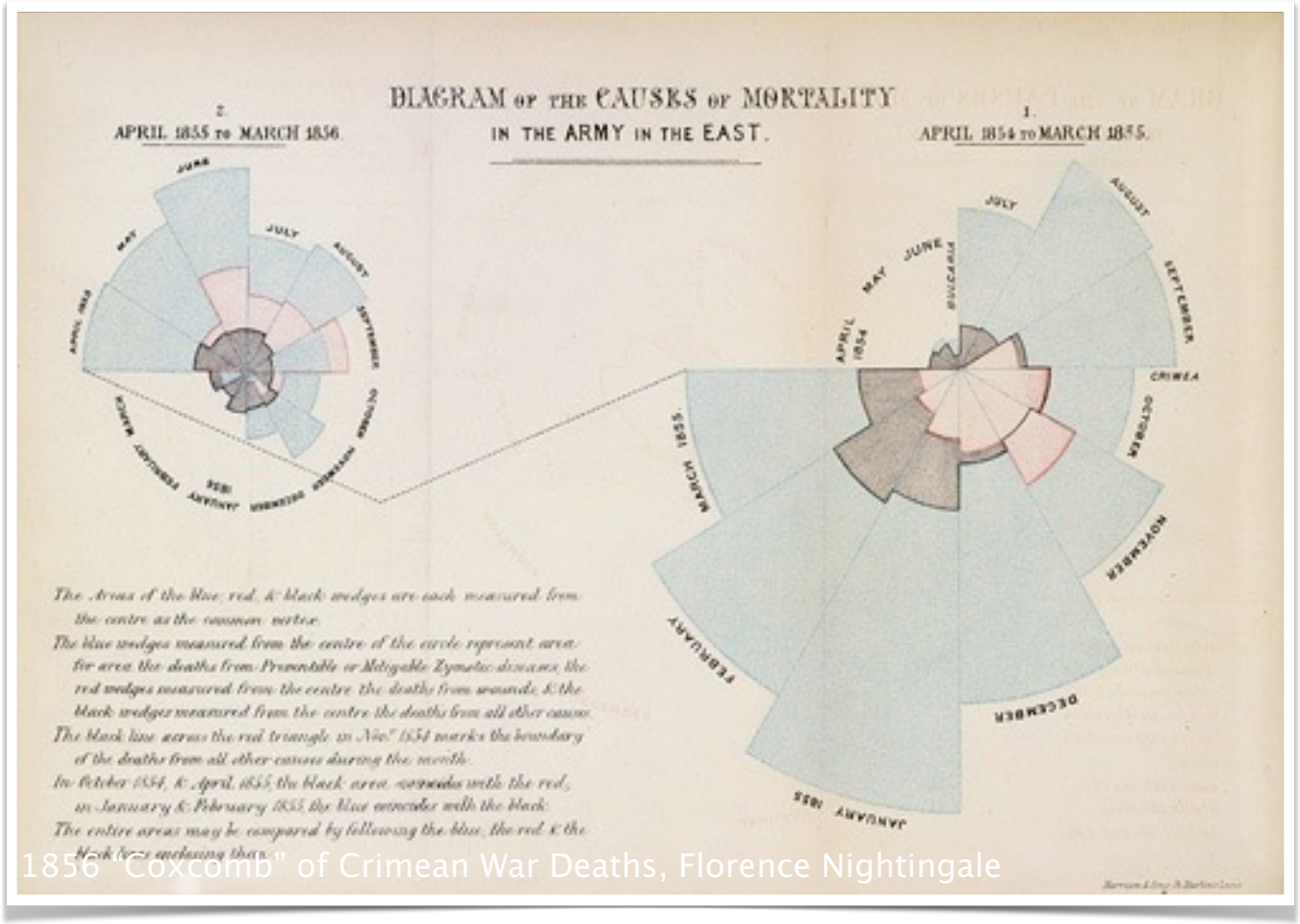




Double helix model [Watson and Crick 53]

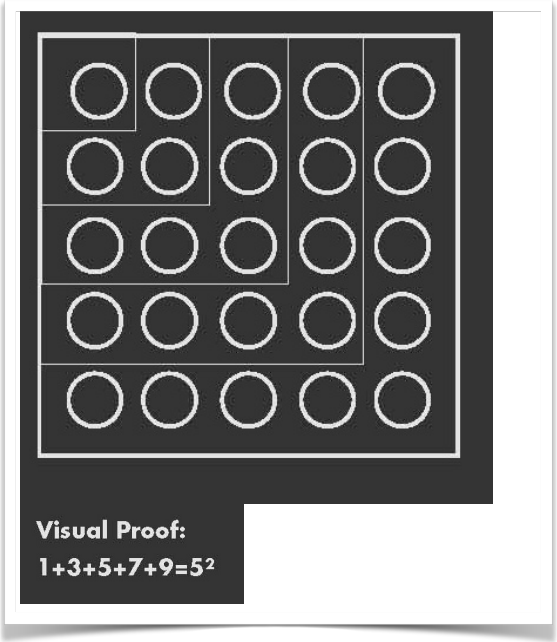
Florence Nightingale

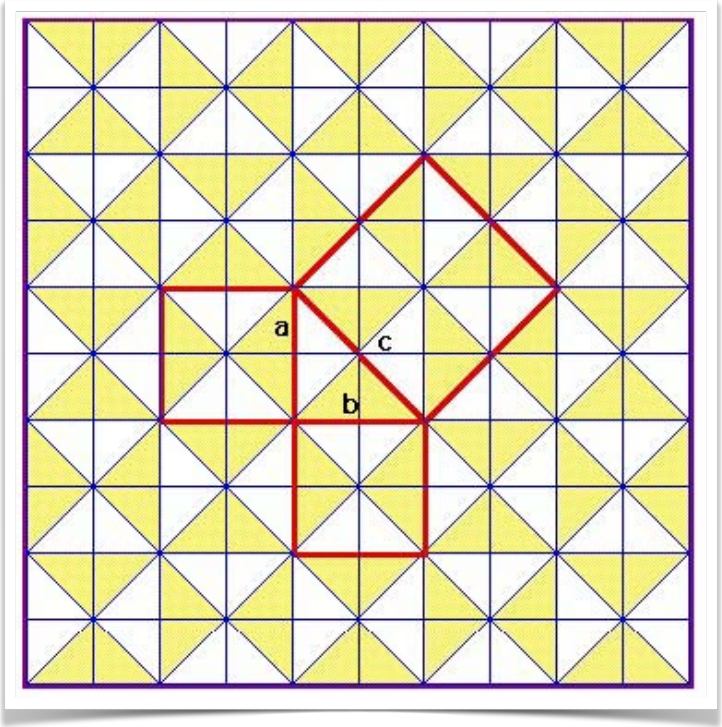
"to affect thro' the eyes what we fail to convey to the public through their word-proof ears"



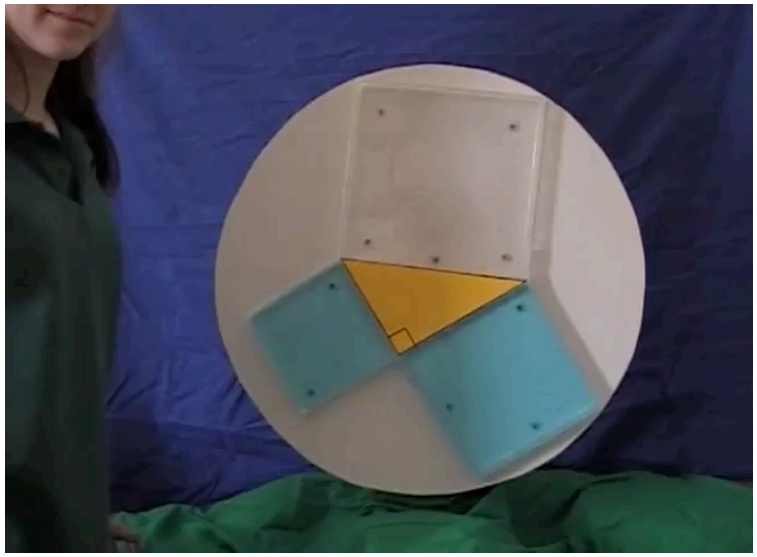
1856 "Coxcomb" of Crimean War Deaths, Florence Nightingale

Visual Proofs





https://archive.org/details/theorem_of_pythagoras
~9 minutes in
Jim Blinn Matematica Series



Behold

Kantor's Diagonal Proof Reals are Uncountably Infinite

$$
\begin{array}{lllllll}
0 . & d_{11} & d_{12} & d_{13} & d_{14} & \ldots \\
0 . & d_{21} & d_{22} & d_{23} & d_{24} & \ldots \\
0 . & d_{31} & d_{32} & d_{33} & d_{34} & \ldots \\
0 . & d_{41} & d_{42} & d_{43} & d_{44} & \ldots \\
\vdots & \vdots & \vdots & \vdots & \vdots & \ddots
\end{array}
$$

3.14159...
1.41421...
1.73205...
2.23606...
2.71828...
0.14285...

3.43625...

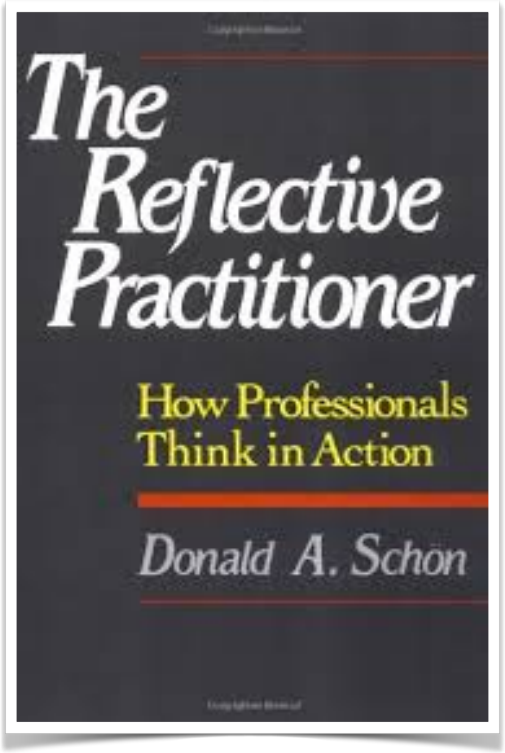
2.32514...

Donald Schön:
Reflective conversations with materials and situations

Donald Schön studied professionals—especially professional designers—for many years. Although his academic home at MIT was in a department of urban design, his subjects of interest have ranged from psychiatrists and social workers to architects and jazz musicians.

After observing and interviewing practitioners in many domains, Schön was able to characterize the common elements in their practices and their ways of teaching new practitioners.

In The Reflective Practitioner Schön drew on examples from these studies to outline the basics of what it means to have and to apply expertise.



Week 1 Required Readings

Interested in your reactions and comments

CHS: Medium: A Human-Centered Information Space: Designing Dynamic Personalized Visual Information

Amy Rae Fox[1], Arvind Satyanarayan[2], Philip Guo[3], Haijun Xia[4], and James D. Hollan[5]

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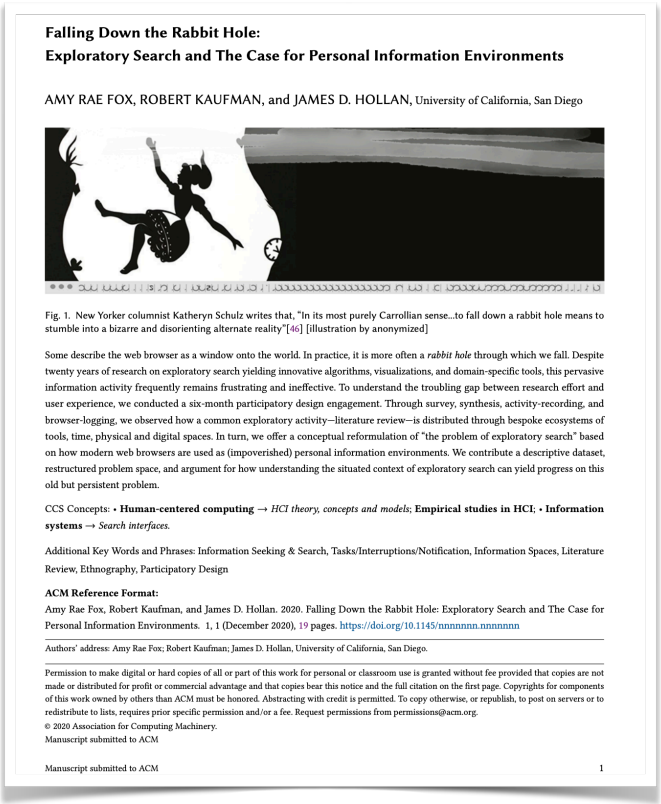
Focusing on the domain of data analysis and visualization and the problem of activity fragmentation, this effort will (1) address the challenges of capturing and representing cross-application information activity, (2) design and evaluate activity-centered representations, (3) develop a cognitively-principled grammar of dynamic information behavior, and (4) integrate these features into a prototype information space realized as a web-based JupyterLabs extension to facilitate systematic evaluation in real-world use and encourage widespread adoption.

Intellectual Merit: The intellectual merit of this effort derives from challenging the presupposition that information is passive data, disconnected from processes, tasks, context, and histories. We propose to move beyond this legacy view and the silos of current applications to design, develop, and evaluate information entities that dynamically alter their appearance and behavior in response to task, history, and context. Developing effective principled composable general rules of behavior as the basis for a dynamic visual information space is the primary scientific focus. We refer to the rules as being *cognitively convivial* because they are specifically designed to operate in ways attuned to our perceptual and cognitive abilities.

Broader Impacts: The broader impacts of the proposed activity derive from the potential to radically improve the efficacy of computer-mediated information activities and reshape how we think with computers. In addition to research publication, all software will be open source and made available via a GitHub repository. Educational impact will result from training students in the interdisciplinary approaches required to design a new generation of information environments, providing research opportunities for graduate and undergraduate students. Student exchanges and interaction with collaborating international research labs will enrich student experience. We will continue to participate in UC San Diego outreach programs to engage students from diverse locations, including the innovative on-campus Preuss Charter School for low-income middle and high school students. Beyond publication, education, and outreach, our goal is to seed crystallization of a research community to further develop and evolve this novel approach for designing and interacting with dynamic information.

Keywords: activity history; application silos; cognitive principles and laws of cognition; cognitive tools; co-adaptive systems; distributed cognition; dynamic media; human computer interaction; information visualization; interruptions; instrumental paradigm; Vega-Lite; Webstrates.



Falling Down the Rabbit Hole:
Exploratory Search and The Case for Personal Information Environments

AMY RAE FOX, ROBERT KAUFMAN, and JAMES D. HOLLAN, University of California, San Diego

Fig. 1. New Yorker columnist Katheryn Schulz writes that, "In its most purely Carrollian sense...to fall down a rabbit hole means to stumble into a bizarre and disorienting alternate reality"[46] [illustration by anonymized]

Some describe the web browser as a window onto the world. In practice, it is more often a *rabbit hole* through which we fall. Despite twenty years of research on exploratory search yielding innovative algorithms, visualizations, and domain-specific tools, this pervasive information activity frequently remains frustrating and ineffective. To understand the troubling gap between research effort and user experience, we conducted a six-month participatory design engagement. Through survey, synthesis, activity-recording, and browser-logging, we observed how a common exploratory activity—literature review—is distributed through bespoke ecosystems of tools, time, physical and digital spaces. In turn, we offer a conceptual reformulation of "the problem of exploratory search" based on how modern web browsers are used as (impoverished) personal information environments. We contribute a descriptive dataset, restructured problem space, and argument for how understanding the situated context of exploratory search can yield progress on this old but persistent problem.

CCS Concepts: • **Human-centered computing** → *HCI theory, concepts and models*; **Empirical studies in HCI**; • **Information systems** → *Search interfaces.*

Additional Key Words and Phrases: Information Seeking & Search, Tasks/Interruptions/Notification, Information Spaces, Literature Review, Ethnography, Participatory Design

ACM Reference Format:
Amy Rae Fox, Robert Kaufman, and James D. Hollan. 2020. Falling Down the Rabbit Hole: Exploratory Search and The Case for Personal Information Environments. 1, 1 (December 2020), 19 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

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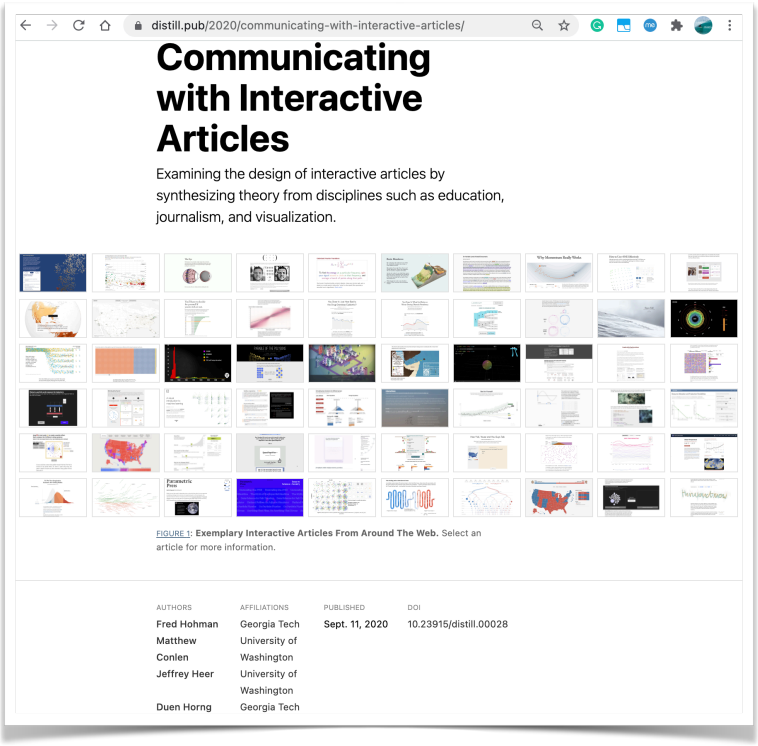
Manuscript submitted to ACM



distill.pub/2020/communicating-with-interactive-articles/

Communicating with Interactive Articles

Examining the design of interactive articles by synthesizing theory from disciplines such as education, journalism, and visualization.

FIGURE 1: **Exemplary Interactive Articles From Around The Web.** Select an article for more information.

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Online Mingling: Supporting Ad Hoc, Private Conversations at Virtual Conferences

16 Pages • Posted: 4 Aug 2020

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Abstract

Even though many people have found today's commonly used videoconferencing systems very useful, these systems do not provide support for one of the most important aspects of in-person meetings: the ad hoc, private conversations that happen before, after, and during the breaks of scheduled events—the proverbial hallway conversations. Here we describe our design of a simple system, called Minglr, which supports this kind of interaction by facilitating the efficient matching of conversational partners. We also describe a study of this system's use at the ACM Collective Intelligence 2020 virtual conference. Analysis of our survey and system log data provides evidence for the usefulness of this capability, showing, for example, that 86% of people who used the system successfully at the conference thought that future virtual conferences should include a tool with similar functionality. We expect similar functionality to be incorporated in other videoconferencing systems and to be useful for many other kinds of business and social meetings, thus increasing the desirability and feasibility of many kinds of remote work and socializing.

MINGLR

- This is beta test software!
- Be sure to mute your Zoom microphone before going to Minglr.
- Minglr works best with the Chrome browser (except on iOS systems where you should use Safari).
- If you have Google or Facebook accounts, you can sign in with them.
  - If not, you can click "sign up with email" and create a new account and password for yourself.
- If you need technical help, send email to minglr.cs@gmail.com.

Breakout Rooms