Disseminating Scientific Development Through Artistic Practice: The HCI History Poster

Abstract
This paper presents two contributions: (i) an algorithm for generating visualizations of the historical interfield relations of a topic within a scientific corpus by parsing scientific literature and linking it using citation metrics, and (ii) a poster generated using aforementioned algorithm, that depicts the historical development of ‘interaction’ within the field of Human-Computer Interaction, based on all CHI papers and their citation data from Google Scholar. Furthermore, we discuss possibilities and limitations of disseminating scientific developments through artistic practice.

Author Keywords
Art history; Scientometrics; Visualization; Poster; HCI

CCS Concepts
•Human-centered computing → Scientific visualization;
•Applied computing → Fine arts; •Social and professional topics → History of computing;

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Background and Introduction
In 1936, Museum of Modern Art (MoMA) had a seminal exhibition on *Cubism and Abstract Art*, for which Alfred H. Barr, Jr. designed the exhibition catalogue front page shown in Figure 2. The graphic, which has become a cornerstone in art history, depicts the emergence of abstract art by linking various historical art movements that influenced its development. Inspired by this form of graphic art, that functions both as an artistic work and as a didactic historical survey of isms, we present a machine generated poster outlining the historical movements for the scientific tradition of Human-Computer Interaction. The purpose here is not to produce a work of art rivalling that of Barr, Jr., but instead providing an example of interplay between science and its own visualization, paving the way for a discussion of the potentials in connecting art and science in a time when artistic and “curatorial projects are increasingly understood as research projects.” [9].

Possibilities in Art as Science and Research Dissemination
Alfred H. Barr, Jr.’s art graphic transcended in 1936 the boundary between art historical dissemination and the artwork itself, making visible historical knowledge in an aesthetic form. Today, in a time of continued focus on cross-disciplinary research, art might be proposed as a fruitful transgressor between boundaries and disciplines, giving knowledge shape and thereby creating new insights for academic and non-academic audiences alike. A humble attempt to visualize the development of HCI is provided in Figure 3, where research and its dissemination is coupled—not with one as the vehicle for the other, but as a dual movement towards the same scientific goal.

For science and technology anthropologist and philosopher Bruno Latour, art can indeed offer an overcoming of boundaries between scientific disciplines [5]. When experiencing Tomas Saraceno’s art installation *Galaxies Forming along Filaments, Like Droplets along the Strands of a Spider’s Web* on the Venice Biennale of 2009 (see Figure 1), Latour...
describes how his own Actor-Network Theory [6] is chal-

lenged dramatically. Saraceno’s piece visualized, in Latour’s

experience, his concept of the network alongside and in-

tertwined its previous opposition, philosopher Sloterdijk’s

concept of the sphere [11].

For Latour, Saraceno’s art installation on the one hand

breaks down oppositions between the scientific concepts

through artistic visualization, making it possible "to com-

plicate the hierarchy of voices and make the conversation

between disciplines move ahead in a way that is more rep-

resentative of the twenty-first century than of the twenti-

eh.” [6]. On the other hand, the artwork “performed pre-

cisely the task of philosophy […] not to overthrow but to

make explicit” [6]. In that sense, art can explicate or reveal

previously unknown connections, which science (and phi-

losophy) also is supposed to pursue.

The experience at the Venice Biennale led Latour to or-

ganize a series of lectures, inviting scientists from differ-

ten fields as well as artists like Olafur Eliasson. Through

a reenactment of the debate between Albert Einstein and

Henri Bergson in 1922, Latour and his guests would “expli-
cate” how art and science can “conjoin forces” [6]. Without

going into detail about the famous 1922 debate itself (where

the philosopher was “defeated” by the scientist), Latour’s

experiment intended to strive past its failure and to establish

new connections between science and art, suited for the

present century—or even millennium—rather than the last.

An interesting example of a combined artistic and research

practice in computer science, is Dexter Sinister’s design of

Meta-the-difference-between-the-two-Font in 2010 for The

Contemporary Condition book series [10]. The series and

the research project behind it investigated “contemporaneity

as a defining condition of our historical present” [7]. In other

words, the project looked into how the very notion of “being

contemporary” defines our current age and what possibil-

ities and implications arise from this conception. Dexter

Sinister derived the font using MetaFont, the computer ty-

pography system developed by Knuth in 1979 [10].

The font is used for the entire book series, of which Notes

on the Type, Time, Letters & Spirits is part, disseminating

the research of the research project The Contemporary

Condition [7] while simultaneously reflecting upon its own

historical analysis. Meta-the-difference-between-the-two-

Font is in that way at once a research experiment, a de-

sign experiment, and a piece of research dissemination,

combining all three—to explicate new connections between

the object of study and its use. Knuth’s MetaFont is both a

programming language and an program interpreter; Meta-

the-Difference-Between-Two-Font and works like Barr, Jr.’s

might be considered an artistic practice and its own artistic

interpreter.

Chronological Information Visualizations

Information visualization research has for long introduced

ways to visualize topics from time series data. An exam-

ple is the Streamgraph [1, 2], that effectively displays large

chronological data sets by showing stacked themes, in rel-

ative variation across time. While such visualization tech-

niques often result in aesthetically pleasing outcomes, the

focus is typically on cognition amplification rather than artis-
tic, as they fundamentally are unambiguous graphs. On the

contrary, work as depicted in Figure 2, albeit time-series,
is constructed with artistic freedom. This both requires the

observer to draw their own conclusions, but also means

that representations are not necessarily dimensionally sta-

table. Other types of visualization that concern causal rela-
tions (but to a lesser degree concern artistic practice) are

Lombardi diagrams, evolutionary trees, and Feynman dia-

grams [13].
Data
We use two data sets for the purpose of generating a historical poster of scientific development of Human-Computer Interaction. The first, by Hornbæk et al. [3] holds all published papers at CHI 1981–2016, their contents, year, and authors. More importantly, the data set contains modifiers of interaction — words that grammatically modify ‘interaction’ within sentences of all CHI papers. These automatically extracted words are further manually categorized into Style, Quality, and Social (other categories omitted for this use). We use modifiers based on their first occurrence at CHI, how many papers they occur in, and their total occurrence. We augment this data set with CHI citation records, sourced by Pohl and Mottelson [8].

Method
The 1936 poster Cubism and Abstract Art, that inspired this work employed a range of typographical styles for depicting historical relevance. Specifically, four typographical styles that denote various semantic relations (see Figure 2) are present:

1. Black uppercase text for notable isms
2. Black capitalized text for prominent artists
3. Red uppercase text with outline for examples of external artistic work
4. Arrows to denote relations

Similarly, we define typographical styles for our purpose of artistic scientific history dissemination:

1. Black uppercase text for notable topics
2. Black capitalized text for prominent authors
3. Red uppercase text with outline for examples of applied research
4. Lines to denote relations

While the order, placement, size, and selection criteria of the original poster are not exactly objective, we define the following rules to allow for a computer-generated version based on scientific literature:

Notable topics
We select the interaction quality modifier [3] originated from that particular period, and that occurs through most papers. We print it to the left with a black typeface. These modifiers are intended to relate to isms from the original poster.

Prominent authors
We select the first author of the most cited paper during the paper. Any paper published in the period with the author as a co-author is then used to extract interaction modifiers. From these modifier we pick (if any) the most occurring quality/style/social interaction modifier [3], and print it alongside the author’s name and year. Authors that are not accompanied by a modifier, did not include interaction modifiers in their highly cited papers during the specific period.

Applied work
We use interaction styles [3] in outlined red typography to show examples of prominent applied research from a particular period, analogous to artistic work. The chosen word is the one referenced across most papers, and that originated from the relevant period.

Relations
We draw lines between authors and modifiers, if any of the papers the author have published mention the used modifier. As this connection is rather loose, we have omitted arrows, such that these lines only represent ‘a connection’ rather than implying heritage or causality.
Duration
The length of a period was set to three years, except for styles for which we used a two-year period. This was a trade-off between having enough, but not too many data points, while making sure that each period would contain prominent work.

Manual Intervention
Because the most occurring modifiers sometimes are quite generic, we hand-crafted a list of stop words that we excluded from the final poster. Such words include ‘computer’, ‘new’, ‘novel’, and ‘normal’.

Aesthetic Choices
The poster is set in Futura, like Barr’s. Size of modifiers are based on their relevance (i.e., number of papers they are referenced in). Social modifiers are printed half-opaque, while quality and style modifiers resemble the aesthetic choices from Barr’s chart.

The Poster
The resulting poster is shown in Figure 3. It is organized in chronological order vertically from 1980-2020 (yet, the data set holds papers between 1982-2016). In a grid-like structure, the poster depicts notable interaction qualities (bold face, left), authors and corresponding interaction modifiers (thin, middle-left), interaction styles (red, middle-right), and examples of social interaction (opaque, right).

Discussion
Our approach to disseminate HCI history is based on the work by Barr, which itself has received critique. Tufte [13] for instance, mentions how its dichotomous view of modern abstract art (non-geometrical/geometrical), is both visually and historically simplistic. Similarly, we cannot claim to have

Figure 3: The computer generated HCI History Poster. The source code and a PDF version in A3 are available at https://github.com/askemottelson/chi-poster.
created an accurate nor complete depiction of the history of interaction within HCI, let alone an art work.

Limitations of our Computational Approach
An obvious limitation of utilizing natural language processing to detect notable topics in scientometric data, is that the most used words are often quite generic, with resulting terms for this data set such as ‘computer-based’, ‘social’, or ‘novel’. These words represent core practices in HCI, and are as such not that interesting. To this end, we defined a list of words to exclude.

Visual links, as understood as causal claims between developments in scientific literature are hard to compute. References in scientific literature are ubiquitous, making it hard from a network analysis perspective to clearly distill which trends emerged from other. As we did not have access to specific references (only per paper citation counts), we used overlapping modifiers to signal references. Unlike the original poster, we organized types of items vertically. Using a graph drawing algorithm (e.g., TikZ spring), the organization of items could have been more interconnected, making it more visually dynamic. We could also have added locations (e.g., from authors affiliations).

Limitations of Art as Science and Research Dissemination
Does art necessarily want or even need to interpret itself? The question’s immediate answer is no, as art is often proclaiming autonomy for artists, in terms of artistic practice, and spectators, in terms of interpretation, alike. In relation to the latter, Latour praises Saraceno’s work for its openness to a multitude of interpretations, depending considerably on the spectator’s perspective and experience of the artwork. Whereas Latour interprets the installation as a model of social theory, one “could just as well see it as biological interpretation of the threads that hold the walls and components of a cell, or, more literally, as the weaving of some monstrously big spider, or the utopian projection of galactic cities in 3D virtual space” [6].

For Latour, the openness to interpretation is a means to cross the aforementioned boundaries; a quality in the work’s ability to cross thresholds of disciplinary engagement. When investigating art as a vehicle for science or research dissemination, one must with this notion in mind consider the perspectives of the spectators. Whereas the supposed purpose of science communication is to transfer the knowledge of the researcher to the spectator, experimenting in the field of science communication requires an acknowledgment of the spectator as a co-producer of the knowledge generated in the meeting between the artwork or piece of dissemination—perhaps even considering the spectator as the object of study.

This is what Horst and Michael suggest in their experiment with science communication [4]. They propose a new model of the science communication event based on emergence, “understood in terms of the coming together of different elements through which novel relations and identities can emerge.” [4]. Through the figure of the Idiot (as coined by Belgian philosopher of science Isabelle Stengers [12]), the authors describe the possible engagement of the uninterested, non-participatory audience of science communication, representing the non-expected reactions and perspectives provided by the unexpected spectator.

This is perhaps a part of what artistic practices can offer science communication; establishing the framework for novel experiences, where knowledge is produced through the interaction between the research-based artwork and its spectators. To that end, the art-research synergy might aid the emergence of new human-computer interactions, as well as bring forward the science of interaction itself.
REFERENCES


