Art on Graphics: Ten Years of Pursuing Value in Art-Science Collaborations

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IEEE Computer Graphics and Applications (CG&A) began publishing "Art on Graphics" as a regular department with its current editors ten years ago in January 2015, with a goal of sharing work we encountered in our professional lives that suggested value provided by art-science collaborations. In the spirit of the ten-year anniversary, we highlight value provided by art-science collaborations that have been shared within the thirty-five articles published by the department. As editors, we continue to pursue the activity of sharing promising art-science work processes and results to enlighten and inspire CG&A readers.

Figure 1 – Three featured images in Art on Graphics articles (left to right: Jon McCormick, Sally Webber, Victoria Vesna).

The *Art on Graphics* departmental began its run as a regular IEEE Computer Graphics and Applications (*IEEE CG&A)* department in January 2015 with the article "Pursuing Value in Art-Science Collaborations" by the editors to introduce the department. The article offered a perspective on pursuing value through art-science collaborations, while highlighting some work to visually engage potential collaborators, and make a commitment to pursue value in order to help readers expand their thinking on value and how value can come from art-science collaborations [1]. In doing so, we encountered art-science collaborators with a varied set of work processes, who produced content via a variety of sensory media, and who offered to share the results of their work along with any feedback they received from those who experienced it (see Figure 1).

In that first article, we introduced a process by which we would map the work we featured in departmental articles into a 3-D information space with axes comprising of three continuums: the intent of the work from art to science; the breadth of the data involved from narrow to broad; and the delivered sensory experience of that work from physical to virtual.

Our hypothesis, which became a goal, was that we'd provide more value by populating the 3-D space fully through a mindful curation of articles. In this article, we present the updated interactive infographic of our subjective placement of the work covered since that January 2015 but, before sharing and discussing that, we offer some perspective we gained through working with the authors of submitted papers, interviewees, and invited authors we targeted.

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Insights into the nature of value in artistic processes grew to where we could identify certain components in those processes that provided value.

Art on Graphics Departmental Growth

As departmental editors, we wanted to highlight the value of art-science collaboration through a variety of value characteristics. As we met effective collaborators, we expanded upon that variety as they educated us about what was valuable. We hoped that highlighting would then provide our readers with useful characteristics they could pursue in their own work. The relevant CG&A issue date appears in parenthesis upon mention of work reviewed.

Figure 2 – Ruth West's ATLAS of the Global Ocean Survey

The ATLAS installation that Ruth West shared with us in that first article (see Figure 2) represented what we considered to be a familiar form of art-science collaboration. She presented the process by which trained artists collaborated with trained scientists to share a process that resulted in a shared visual result – in her case, an ethereal and dreamlike immersive 3-D environment wherein an audience could explore a life-size rendering of the Global Ocean Survey (Jan-Feb 2015). The work fits into a broad category of work that both enables awareness of, and motivates investigation into, climate change.

Karin von Ompteda and Kevin Walker's work on translating the quantum world to human scale provided another genre of how artists and scientists can come together to create art-inspired experiences with an intent to make hard-to-grasp scientific concepts approachable for audiences (May-June 2015).

Andrea Polli went as far as to coin the term *slow vis* in sharing her *Particle Falls (*see Figure 3, left), *E-Oculus*, and *Skylight* climate-related work with collaborations that she demonstrated benefit greatly from slowing down the work generation process (Nov-Dec 2015).

David Goodsell's work painting images of the inside of cells, as well as other molecular scale objects, provided evidence that long-term art-science relationships can enable an artist to contribute to the scientific process by facilitating insight and suggesting possible hypotheses worth exploring (Nov-Dec 2016).

Sally Weber's work on *Lightscape*, *Focal Point*, and *inFLUX* demonstrated the value an artist can provide in collaborations with scientists by staying focused on a particular perspective of seeing for a long time (May-June 2018).

Victoria Vesna's work on *Noise Aquarium* and *Bird Song Diamond* offered evidence that an alternative art-science process can enable awareness of where and how science is progressing on climate assessment. In her genre of work process, collaborations grow over long periods of trust-building between art and science collaborators to where those relationships then evolve into engaging audience experiences (July-Aug 2019).

After the first five years of Art on Graphics articles, we had accumulated enough experience with authors to begin to hypothesize some common threads that make art-science collaborations successful with regards to the artists' contribution.

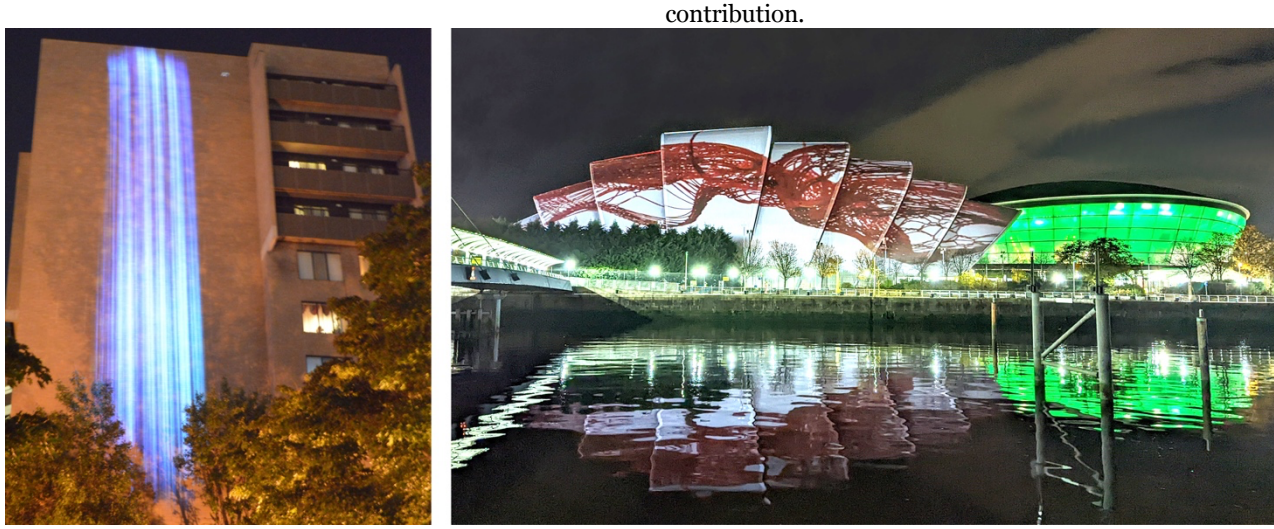

Figure 3 – Two more featured artists from Art on Graphics articles (left: Andrea Polli, right: Beatie Wolfe)

Primary and common to successful works, we found layers of entry points and diversity of content elements that enabled engagement with broad audiences. The diversity aspect suggested that we might pique our readership's curiosity through pursuing non-conventional use of materials and/or medium, content presented from a novel dimension or unexpected perspective, and work accessed through multiple sensory modes. Secondary common threads included acknowledgement as to the role and power of beauty, a connection to nature, and an invitation to learning. The more an artist's work incorporated these features, the more eager we were to pursue departmental articles with them.

As we teased out common characteristics of successful work, we realized both Andrea's and Victoria's work embodied six components that we hypothesized to be drivers of success. We realized that another artist from that first departmental article, Nathalie Miebach, embodied these six components as well:

- Curiosity: Does the work stop us in our tracks? Are we motivated to explore and decode the work? Does it offer us a view of something unseen or unfamiliar?
- Real-time Interaction: Does it reflect the present, thus connecting with our lives? Does it enable us to engage with the work, either by interaction or immersion?
- Communal Experience: Does the work address concepts bigger than ourselves? Does it facilitate a shared experience of wonder, knowledge, or controversy?
- Multi-sensory/Immersive: Can we perceive and interpret the work using multiple senses: see, hear, touch, smell, and feel it?
- Diversity of Perspectives: Are there multiple points of entry, and dimensions that can speak to a wide audience? Are there layers of metaphor to explore and ponder? Does it draw in a wide audience through multiple channels?
- Time-Tested: Does it continue to draw and resonate with audiences over time?

The emerging awareness of these characteristics of success now guides our departmental work. For example, we realized that Nathalie's work deserved a full-length article for our readership to consider her process from the standpoint of craftsmanship in their own work practices and cover her collaborative processes (see Figure 4) across multi-sensory delivery methods (May-June 2022).

Figure 4 – Nathalie Meibach's collaborators of a musical score to support her physical weather event sculpture

We pursued Dietmar Offenhuber for an article that would share his work on autographic data, and the perspectives he gained on the nature of data. He continues to inspire us with his well-thought-out arguments regarding physical data, obtained in the pursuit of understanding climate, as valuable traces that can have long-tail relevance to a wider user base. His work (see Figure 5) makes us question the data acquisition and publishing process from start to finish (Sep-Oct 2020).

Figure 5 – Examples of Dietmar Offenhuber's installations

As artificial intelligence reached a boon period of methods and results, we encouraged Jon McCormack to contribute an article that introduced his incorporation of artificial intelligence into an artistic practice over a long period of time, so as to tease out a practice of successful collaboration of artist with AI tools and techniques (Mar-Apr 2024).

We invited Beatie Wolfe (see Figure 3 right, and Figure 6) to share her work practice in an article whereby we could demonstrate diversity at its finest. Beatie's practice of

delaying design decisions until after her medium and message let possible design directions breathe, until a best one emerges, appeared to pull heavily from all six successful characteristics of artistic practices (Sept-Oct 2024).

Figure 6 –Beatie Wolfe at part of her imPRINTING exhibit

Revisiting all 35 Art on Graphics departmental articles, we found artistic contributions to science did not necessitate success for the art outside of the scientific context. Identifying and sharing contributions to science, through collaboration, remains a characteristic of value.

Haru Ji and Graham Wakefield's work on *Fluid Space*, *Time of Doubles*, and *Archipelago* (Jan-Feb 2016), as well as Pedro Cruz and Penousal Machado's work on *A Figurative Approach to Traffic Visualization* (Mar-Apr 2016), highlighted possible value-added methods in taking successful visualization techniques from science sub-domains and applying the techniques to visualize data in a new sub-domain. Identifying where scientific practice can provide contributions to artists, through collaboration, also remains a characteristic of value.

On the subject of communicating differently, we have come across performance-based presentation techniques from live theater infused with virtual reality and augmented reality (Mar-Apr 2018) to hearing-infused experiences (May-Jun 2019) and comic strip deliverables (May-Jun 2017).

By mixing in a distinguished historian, Tom Chandler and Adam Clulow showed how art-science context can be provided by a virtual reconstruction of lost societies back in a time when climate was different than it is today (May-Jun 2020).

Eleanor Lutz (Jan-Feb 2019) and Morgan Barnard (Nov-Dec 2018) surprised us when sharing their processes of visualizing large vetted data sets in the public domain, without any engagement with the scientists who discovered and/or documented the data. Although they diverge widely in the media they use, they convinced us how motivational and useful their process is to them for investigating their own interests in climate perspectives. The results look and inspire us differently than what we'd expect from scientific training and practice alone.

Figure 7 – A frame from Dennis Hylnsky's high shutter speed time lapse video capture of vultures in North Carolina

We first used an interviewing technique in a departmental article for our tenth article. We quickly realized that interviews tended to facilitate us cutting to the core of where value lay in art-science work, because it was at the forefront of our minds throughout the interviews. The process of talking openly with Dennis Hlynsky (see Figure 7) generated insights that we made the focus of an article entitled *Murmurations: Drawing Together Art, Visualization, and Physical Phenomena* (Jul-Aug 2016)

We are often surprised where our interviews lead when we have a very lightly-scripted outline of topics to pursue heading into them. It's natural for us to lean into mentioned insights that are relevant to our own work, with the enthusiasm in expecting them to be useful to readers. Insights generate questions that generate more insights when an interview is going well. That phenomenon occurred for Bruce as we interviewed Nathan Selikoff for an article entitled *Explorations in Higher Dimensionality and Complexity* (Sept-Oct 2023) and made connections to Bruce's work. It occurred for Francesca in the Beatie Wolfe article mentioned previously.

As we have become more seasoned interviewers, we have relied upon the interview format when other formats have not produced the spotlight on value that we find we can shine during interviews.

Less Words More Images

The Art on Graphics article with the least number of words highlighted an approach by Benjamin Bach, Nathalie Henry Riche, and Sheelagh Carpendale, which demonstrated a medium of research communications being done via data comics (see Figure 8). That approach mixes text, tables, images, and graphs to provide possible value in published communications (May-June 2017).

As the Art on Graphics department matured, we committed ourselves to the value of imagery over text as we ran up against article page length quotas. This produced a

downward trend in the number of words per article over time (see Figure 9). We are not surprised to see a trendline that slopes downward towards fewer words over the first six years' worth of articles. We grew an appreciation for how many words each image represented and then wanted to see more images in departmental articles. As a result, we worked with authors to pursue better images and concise wording to make room for them within page count limits.

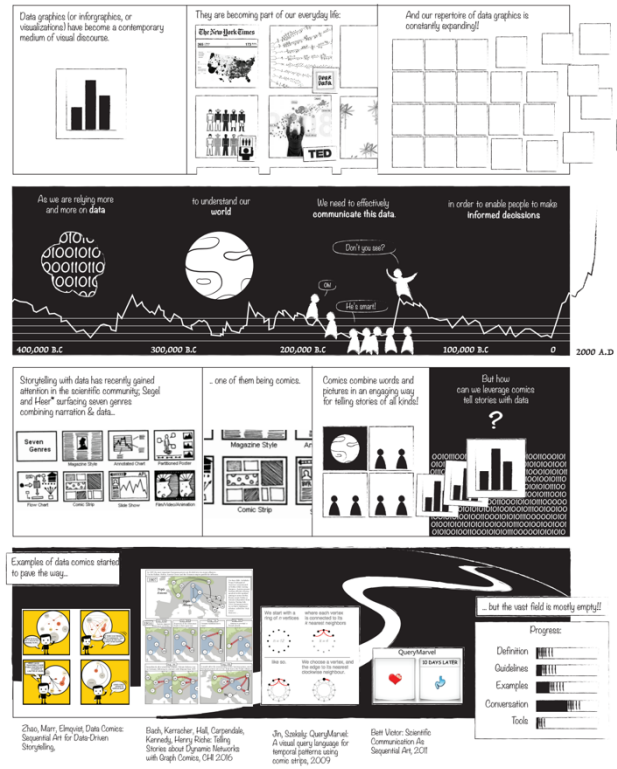

Figure 8 – Example data comic from Benjamin Bach's data comic collaborations

In comparison, the more recent four years have seen a steep increase in the number of words, which we attribute as likely being a by-product of us focusing on more complex art-science processes, when then required longer text-based explanations. Characteristics of work process became an even more explicit source of art-science value as we highlighted the uniqueness of those we featured in articles. At the same time, page count limits have been relaxed such that we have had room for more words without having to sacrifice the number of images.

The Interactive Infospace Grows

Continuing with the interactive visualization idea we introduced in 2015, we expanded the 3-D visualization product, introduced in our first article, to include all the work from art-science work highlighted in Art on Graphics articles through 2024 (see Figure 10).

Looking at our subjective placement of glyphs within that tool, we notice our collection spreads out evenly within the volume except in the spaces at the broad end of the narrow-broad dimension and science end of the art-science dimension. We also notice that the highlighted work is generally more art than science, but that reflects our intent over time as we realized the niche we provide in conjunction with other CG&A departments. The interactive version at bdcampbell.net/ieee/cga/aog/vis.html provides clickable glyphs for better identification of the placement of work within the volume.

A word cloud using all words for 35 Art on Graphics articles appears in Figure 11 for the benefit of all readers who find word clouds a useful infographic, as provided in other CG&A departmental retrospectives published in the past.

Ten years of articles provides us a perspective on the body of work of the Art on Graphics department. This department maintains an ongoing commitment to sharing interesting art-tech-science innovations infused in work relevant to the CG&A community, as suggested by online departmental guidelines [2]. We continue to welcome contributors from art-tech-science teams and individual contributors and hope we will continue to share their work as valuable to our readership for many more years to come.

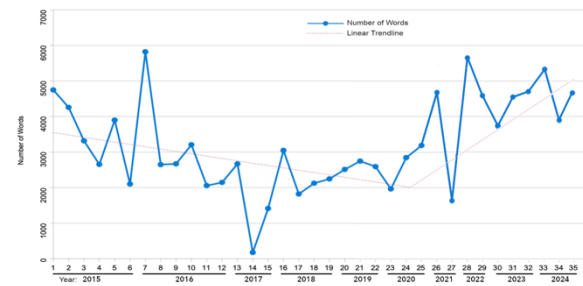

Figure 9 – Word count for all Art on Graphics department articles covering January 2015 - December 2024. The trend line towards less words during the first six years of that period deflected to a trend of increasing words the last four years.

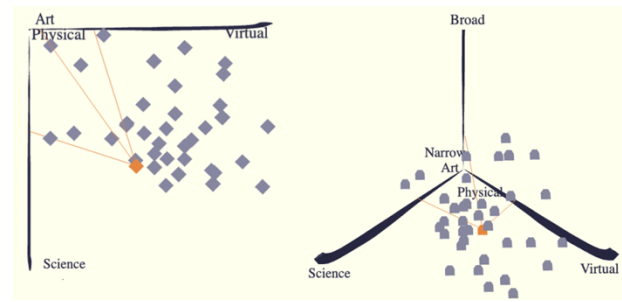

Figure 10 – Placement of Art on Graphics departmental articles in a 3-D infospace. The smaller inset on the left shows a top-view of just two dimensions, suggesting a bias towards art as opposed to science. The orange highlighted article sits at the closest mid-point for all three axes.

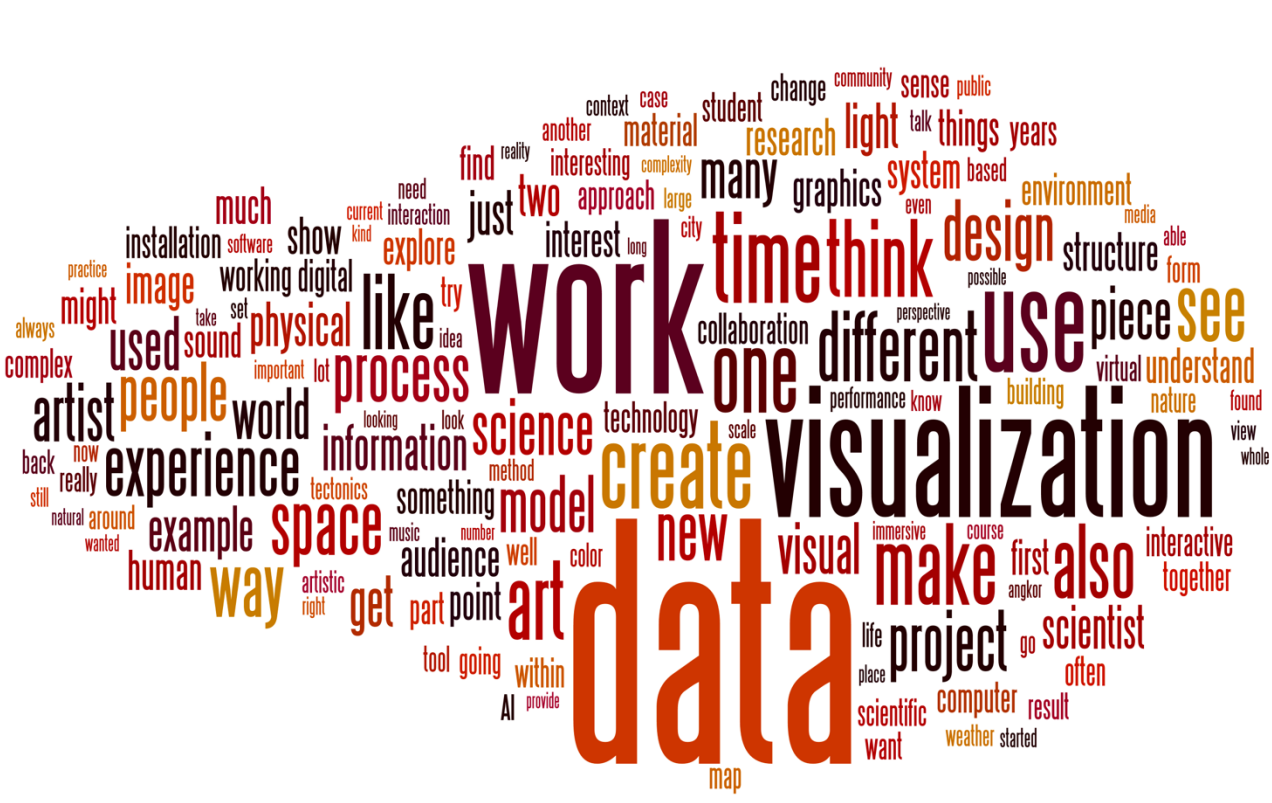

Figure 11 – Wordle word cloud created from the first ten years of Art on Graphics articles. The words art, artist, science, and scientist appear of significant size but other words that appear larger or smaller in size provide perspective on their cumulative frequency.

About the Authors

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References

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[2] CG&A Department Guidelines, Art on Graphics, https://www.computer.org/csdl/magazine/cg/write-for-us/15472?title=Department%20Guidelines&periodical=IEEE%20Computer%20Graphics%20and%20Applications