Leonardo Just Accepted MS.
doi: 10.1162/LEON_a_01065

This article is a part of Special Section of Leonardo Transactions titled "Highlights from the IEEE VIS 2013 Arts Program (VISAP'13), edited by Angus Forbes." Please read the editorial introduction to this section here: http://www.mitpressjournals.org/doi/pdf/10.1162/LEON_e_01059

ART AND SCIENCE AS CREATIVE CATALYSTS

Eleanor Gates-Stuart, Australian National University (ANU), <eleanor.gatestuart@anu.edu.au>; Chuong Nguyen, ANU, <chuong.v.nguyen@gmail.com>; Matt Adcock, Commonwealth Scientific and Industrial Research Organisation (CSIRO), <Matt.Adcock@csiro.au>; Jay Bradley, Pufferfish Ltd, <jay@PufferfishDisplays.co.uk>; Matthew Morell, International Rice Research Institute, <m.morell@irri.org>; David Lovell, CSIRO, <David.Lovell@csiro.au>.

Abstract

Science, Art and *Science Art collaborations* are generally presented and understood in terms of their *products*. We argue that the *process* of Science art can be a significant, even principal benefit of these collaborations, even though it may be largely invisible to anyone other than the collaborators. Hosting the Centenary of Canberra Science Art Commission at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has shown us that while Science and Art pursue orthogonal dimensions of creativity and innovation, collaborators can combine these directions to access new areas of imagination and ideas.

The insights presented in this paper (and its more detailed companion [1]) are an unexpected by-product of the Science Art Commission that brought the authors together for the "production and presentation of a new work of art for the Centenary of Canberra that symbolizes science achievement in the ACT" [2].

While the Commission—awarded to Canberra artist Eleanor Gates-Stuart for her proposal StellrScopƐ—clearly specified the creation of a product, the process took all of us into new creative territory. Our aim is to capture and articulate aspects of Science Art that only became apparent to us through our work together and by first-hand experience of interactions, idea and innovations that would not have happened if scientists and artists had been left to their own devices.

Context

The nature of the Commission (Art) and the host institution (Science) provided opportunities for creative connection and interplay (Science Art).

StellrScopƐ focused on the science and history of *wheat*, an organism whose evolution is intertwined with our own, and whose history connects to the Canberra region from the 1800s—the time of William Farrer ('father of the Australian wheat industry')—through to today's research at CSIRO.

CSIRO has a major presence in Canberra, a strong focus on wheat research and development, and a long history of supporting the productive interaction of Science and Art, through commissioned works, exhibitions and events.

Collaborations

Even though Eleanor Gates-Stuart's residency in CSIRO came about through a Commission whose focus is on wheat, some of the *products* of that residency are not obviously wheat related. Their relations lie in the collaborative process and, similar to Edmonds et al. [3], the case studies we mention illustrate "...how, in creative work, exploratory ideas and acts arise *during* the process and sometimes as side effects rather than from the explicit objectives being pursued at the time."

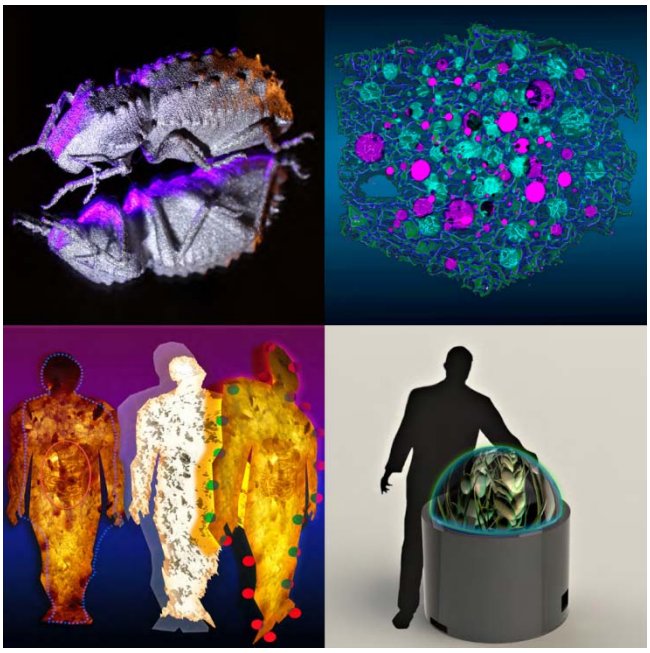

Fig. 1. (From top, left to right) Titanium Bugs, Invisible Bubbles, Bread Man concept, StellrLumé/PufferDome concept. (© Eleanor Gates-Stuart)

Gates-Stuart's initial exploration of the diversity of science at CSIRO included the natural colour 3-D digitization system being developed by Chuong Nguyen [4]. At the time, this system was in its early stages and a typical path would have been to refine it until a level of accuracy had been achieved sufficient to warrant publication in a scientific journal. However, Gates-Stuart and Nguyen both saw the *artistic* potential of the models that the prototype could capture, and that the accuracy of the reconstructions was more than "good enough" for (artistically) creative purposes. This interplay between Art and Science led to a number of large-scale works seen by thousands [5]. Like many other research organisations, CSIRO seeks to raise public awareness of science, yet science culture places a strong emphasis on peer-reviewed publications in journals that garner a focused and relatively limited readership. Here Art and Science catalysed works of artistic merit that enabled scientific research to reach a larger audience [6].

Insects figure highly in the production of one of the world's major food crops. Gates-Stuart's discussions with Zimmerman Fellow in Weevil Research, Rolf Oberprieler, highlighted the impact of the wheat weevil (*Sitophilus granarius*) on stored grain. This led to contact with CSIRO's X-ray and Synchrotron Science and Instruments team, who graciously scanned a specimen in the Australian Synchrotron. Discussion of the results on CSIRO's internal social media prompted the suggestion to 3D print the model in titanium. In short, Gates-Stuart had catalyzed a collaboration involving entomology, synchrotron science, computer vision, 3D reconstruction and printing in titanium.

Closer to wheat and its products, Gates-Stuart had been challenged by Matthew Morell, Future Grains Theme Leader and StellrScopƐ sponsor, to transform the "invisible Universe" into the realm of our senses: Morell asked Gates-Stuart to render *"pictures of holes…one of the most important things in bread."* Gates-Stuart's responses fostered collaboration across different (and distant) groups in CSIRO to use X-ray CT to gain insight into the voids that form during dough development, and which determine texture, consistency and baking

Leonardo Just Accepted MS.
doi: 10.1162/LEON_a_01065

properties. It also led to the creation of "Bread Man", a man-sized, man-shaped loaf that could be sliced to reveal aspects of the human digestive system. When [1] was drafted, we had solved how to acquire a full-body 3D model but it was only after publication that Gates-Stuart had worked out how to "bake" the man, using expanded polystyrene foam rather than actual dough.

The last collaboration catalyzed by Gates-Stuart's residency was the centerpiece of StellrScopƐ and a concept arrived at through discussion with a broad range of national and international experts in projection. Through these conversations we began to settle on the idea of a *StellrLumé*: a projection inside a translucent hemisphere of a size that people could stand around or perhaps even interact with. We learned of Pufferfish Ltd., an Edinburgh-based company specializing in interactive spherical displays (PufferSphere®) but still faced a major challenge as to how to deliver content that people (possibly *many* people) could interact with? Matt Adcock proposed an innovative, practical solution that reinforced Gates-Stuart's artistic practice of layering images and information. An overhead Kinect depth camera would relay information about objects (e.g., hands) placed over the hemisphere; this "virtual shadow" data would be used to mask one video stream projected on to the hemisphere to reveal a second different video stream. In effect, people could cast shadows onto the hemisphere yet, instead of causing an *absence* of illumination, these shadows would reveal the *presence* of a new, precisely registered and synchronized layer of imagery.

Conceptualization

Our experience of the *process* of Science Art collaboration in StellrScopƐ has been extremely positive. It has brought people together who would not otherwise have met; it has sparked insights that would not otherwise have been glimpsed; it seems to have liberated people to think in ways that they would not have otherwise entertained. These experiences have been felt by scientists and artist alike.

As we examined this situation for clues as to why this may have happened, we felt we had experienced a constructive interplay between *scientific* creativity and *artistic* creativity, and we conceptualised this model as shown in Figure 2. Our model posits that, in isolation, scientific and artistic processes pursue orthogonal "directions" of creativity but, in combination, they allow their participants to access new areas of ideas, imagination and innovation. We note that successful collaborations between Science and Art presume some human factors not explicitly shown in Figure 2: the right approach and attitude from the collaborators.

Critique

This model is consistent with ideas articulated by Gold [7] who writes that "artists are like the scientists, looking for, dare I say it, Truths, even if only personal ones" and for whom "the intellectual divide (articulated in C.P. Snow's 1963 book) between the cultures of science and the humanities simply did not exist" [7, p.xv]. Our experience—particularly within the multidisciplinary environment of CSIRO—suggests that there are far more than two cultures to be mindful of. Weibel [8] pointed this out when he wrote "...there are not only two worlds, but n worlds, chemistry, mathematics, ... the universe of science is separated into many sub-universes very similar to the separation of art and science."

In StellrScopƐ, Art has been like a ticket to—and passport between—several Science cultures, including plant science, entomology, materials science, computer vision, bioinformatics and X-ray imaging. It could be argued that these sorts of collaboration arise naturally within Science and research organisations as problems arise that demand multidisciplinary solutions. But time and again, we saw how an approach from an artist engaged scientists of different persuasions in a uniquely disarming way. Gone was the wariness, the *"yes… what do you want (from me)?"* that can appear in response to approaches from other scientists, replaced instead by animated and enthusiastic discussion, generally concluded by enquiries of *"how can I help?"* True, this says a lot about the approach of the artist, but the opportunity to talk about Art and Science generated interest and engagement from scientists at levels that should warrant attention from anyone, or any institution, seeking to foster multidisciplinary research.

References and Notes

* Based on a presentation given at VISAP'13, 13-18 October 2013, Atlanta, Georgia. The IEEE VIS Arts Program (VISAP) is a forum that encourages dialog about the relationship between aesthetics and visualization. The theme of VISAP'13 was Art+Experiment.

1. Eleanor Gates-Stuart, Chuong Nguyen, Matt Adcock, Jay Bradley, Matthew Morell, and David Lovell. "Art and Science as Creative Catalysts." In Proceedings of the IEEE VIS Arts Program (VISAP), Atlanta, Georgia: IEEE, 2013. http://visap.uic.edu/2013/papers/Stuart_CreativeCatalysts.pdf, accessed 12 November 2014

2. Centenary of Canberra Unit. Request For Proposal: CENT: 2011.18258.110. Centenary Science Art Commission on behalf of the Centenary of Canberra, Oct. 2011.

3. E. A. Edmonds, A.Weakley, L. Candy, M. Fell, R. Knott, and S. Pauletto. The studio as laboratory: Combining creative practice and digital technology research. International Journal of Human-Computer Studies, **63**, No.45 (October 2005) pp. 452–481.

4. Nguyen, Chuong V., David R. Lovell, Matt Adcock, and John La Salle. "Capturing Natural-Colour 3D Models of Insects for Species Discovery and Diagnostics." *PLoS ONE* 9, no. 4 (April 23, 2014): e94346. doi:10.1371/journal.pone.0094346.

5. Canberra Enlighten Festival. Projection artists|enlighten, Mar. 2013. http://enlightencanberra.com.au/projection-artists/ accessed on 12 Nov 2014.

6. CSIRO. Insect of the week: Attack of the Giant Bugs. http://csironewsblog.com/2013/03/07/insect-of-the-week-attack-of-the-giant-bugs/ accessed on 12 November 2014.

7. Gold, Rich. *The Plenitude: Creativity, Innovation, and Making Stuff*. Cambridge, Mass.: MIT Press, 2007.

8. Weibel, Peter. The Unreasonable Effectiveness of the Methodological Convergence of Art and Science. Springer, 1998, 167--180.

Fig. 2. Our conceptual model of the constructive interplay between artistic creativity (which deals in *subjective* interpretation) and scientific creativity (which deals in *objective* interpretation). (© Eleanor Gates-Stuart)