Citizen Science & Art/Science Synergies and Future Potential

Executive Summary

The arts can effectively respond to diminishing societal trust in science, contribute to the creation of public discourse and understanding of science, facilitate knowledge transfer between science and society, and stimulate innovation. Artistic interaction with science opens new pathways far beyond illustrating science. Artists can enter into a dialogue with researchers and scientists that is either critical or supportive Art has the power to emotionally reach out to citizens and to interest but also engage them in a scientific process[2].

Recently, programmes in the arts, in science, and to a limited extent in technology include actions targeting the interaction of artists with research projects[3]. This brief was developed with contributions from experts in both fields. There are clear synergies between these concepts and the benefits of considering them together. This document highlights how art can support citizen science and vice versa.

The document concludes by recommending to consider citizen science and the arts jointly, to strengthen synergies by building on existing initiatives, to launch targeted actions regarding education and training, and to launch art-science initiatives. This brief was developed within the framework of the Horizon 2020 project 'Doing It Together Science' (DITOs).

Figure 1 Detail of Anna Dumitriu's installation Make Do and Mend. The central piece is a wartime dress that was a controlled commodity during the war (CC41). The holes and stains in the old dress are patched with silk. This silk has had E. coli bacteria grown onto it using a dye-containing growth medium[1].

Creative Sense-Making of Our World

Citizen science and art/science approaches represent two influential and steadily evolving concepts in research practice that are used differently by various stakeholder groups.

Citizen science (CS) refers to the "inclusion of members of the public in some aspect of scientific research", such as co-creating research questions, data collection and analysis or volunteer computing.[1] The field is very diverse and includes multiple forms of collaboration between academic and citizen scientists. The European Citizen Science Association (ECSA) put forward 10 principles of what constitutes good citizen science.[2]

Art/science refers to creative artistic processes and practices at the interface of the arts and science (and technology). This includes artistic reflections on scientific developments, co-creative processes of artists and scientists, and creative cooperation between artists and scientists or engineers. Resulting works of art typically emerge from science and technology contexts or are themselves realized by means of new scientific and technological means. The art/science field is highly dynamic and developing and includes diverse directions such as artistic research with scientific goals or art/science interaction for innovation.

Links Between Citizen Science & the Arts

Art/science practices and CS share numerous concerns, values and outcomes despite their distinct agendas[4]. Recognising these commonalities makes it easier to design policies in ways that can simultaneously support both movements. The arts have the power to change the ways in which we see the world and to affect our future actions. An artistic approach can be hugely successful when it comes to conveying messages that might be difficult to communicate by any other means. The arts have the greatest ability to visualise our reality including the reality of the techno-sciences.

Art/science – a long tradition

Art showing a creative interest in science and technology is not new. Historically, arts and techno-sciences were

considered a single field of practice. Due to scientific, technological and artistic specialisation in the 19th century, the fields diverged. A renewed interest of the arts in technological and scientific developments re-emerged after WWII. The arrival of the Internet not only led to the distribution and democratisation of artworks, but also the wider perception of technology and its development as a creative process and a new diversification of the artistic canvas: net art, code art and an online performance space. Art and creativity using new media and technologies as a way of expression also led to the innovation of those technologies.

Variety of art/science interaction and public outreach

Recently, discussions about how the arts collaborate with science and technology gained momentum[5]. The arts can make science and technology developments tangible and meaningful for the public by involving the public in the metaphorical prototyping of that same technology. Artistic involvement can lead to new ways of thinking in emerging science and technology fields.

Collaborations between artists and scientists vary from informal bases in which artists and researchers work together in long-term relations, to formal-institutional collaborations in shared laboratories. They vary from an art-as-technology-promotion and science communication to in-depth collaborations on equal terms[6].

There are institutions that focus on strongly science-oriented investigative arts such as Kapelica Gallery in Slovenia and Arts Catalyst in Great Britain. There are also festivals that have an interest in techno-sciences oriented artistic expressions such as Transmediale in Ars Electronica[4] and awards such as VIDA, and the Bio Art and Design Award. Further, the Collide@Cern programme offers artists a very specific techno-scientific research context for work and collaboration.

How the arts facilitate citizen outreach

Citizen involvement in research requires openness, outreach, and interaction of scientists with citizens.[4] Many art/science interactions prepare the grounds of such open access conditions.

The creation of material works has a key role in art/science interaction. Art pieces transgress the traditional formal communication limits of scientific publishing that focus almost entirely on rationalizations. Observers of the pieces or performances experience a more immediate and emotional reaction towards artworks. Artistic pieces can create an opportunity to almost instantly develop a connection with the artwork. Such connection may then lead to discussions and reflections about the underlying conceptual work of the artist and the scientist and reach new audiences.

Moreover, artworks have the potential to catalyse continued media interest and generate opportunities for longer-term attention. Their materiality affords repeated and long-term physical presence, for example in exhibitions, at workshops, or in public spaces, offices and laboratories[3].

- The materiality of the artefacts creates opportunities for involving and connecting with new audiences, often in an emotional way.
- Artworks (artists) often receive invitations to workshops and exhibitions for years after a specific art/science project or be offered permanent installation of selected artworks in public spaces. This means durable interaction but may also require a process of curation and contextualization.
- Usually, the same artwork may be shown in very different contexts and to different audiences – from art spaces to universities.
- In art/science interactions scientists often expand their networks beyond the scientific community and reach out to new audiences including a broad public.

Works of art need not be material; artists also choose performances and interactive elements are now common. Interaction facilitates feedback from citizens and can itself become subject to scientific investigation (cf. Example 3) thus stimulating a **cititzen – science circle**. Artistic creations **have motivated the public to suggest research topics** for scientists to address.

How citizen science enables art/science

Many CS projects make the generated data accessible or contribute to the development of **freely usable research tools and methods**. In this way, CS projects with **open data sharing and licensing policies** enable citizens and artists to acces project results.[5]

In some art/science projects, the interaction with a broad audience plays a central role, e.g. when spectators of a performance become subjects of art/science interaction experiments. **These cases blur the boundaries between artists/spectators/experimentors/scientists**.

CS and art/science interaction can generate new perspectives on research subjects. Participatory research projects allow asking questions about the **philosophical and conceptual foundations of the research context**. Instead of accepting the existing ways in which science is articulated, researchers can work with affected groups to design research projects that are suitable for all stakeholders involved.[6]

Example 1: Anna Dumitriu: Make Do and Mend
http://annadumitriu.tumblr.com/FEAT
A wartime women's suit is the canvas upon which artist Anna Dumitriu paints the history of antibiotics (See Figure 1). The holes and stains in the suit are patched and embroidered with silk that has been dyed with E. coli bacteria cultures. The artist edited the genomes of the bacteria using a cutting-edge technique called CRISPR to remove an antibiotic resistance gene accompanied by homologous recombination to scarlessly repair the break with a fragment of DNA encoding the phrase "Make Do and Mend".

This work literally patches or 'repairs' the bacterium similar to the dress being patched with the cloth. It points to the serious issue of antibiotics requiring control as a commodity. The repair fragment of the DNA inserted into the genome of the

bacteria says "Make Do and Mend" in ASCII code. The work questions how new technologies enable us to 'mend' issues that past scientific innovations have created. It challenges our thinking about past technological glitches.

Dumitriu's work is a material work of art to which citizens react rationally and emotionally. Elderly people at the exhibition told the artist about their own wartime experiences. It triggers an interest that ofen carries on to a discourse about genetic modification and new technologies.

Example 2: Making Sense – Citizen Sensing Toolkit

https://starts-prize.aec.at/en/making-sense-citizen-sensingtoolkit/

The EU project 'Making Sense' showed how local communities can use open-source soft- and hardware, maker practices and open design to appropriate their own sensing tools and address environmental problems, e.g. in air pollution or noise. Based on pilots in Amsterdam, Barcelona and Prishtina, Making Sense developed a toolkit for participatory sensing to enable collective awareness for sustainability.

The pilots led to a conceptual and methodological framework for participatory environmental maker practices, called "citizen sensing". The tools enable active intervention to change our individual and collective practices, and a hands-on transformation of our environment.

The project won an honorary mention for the STARTS prize of Ars Electronica 2018. It blurs the boundary between art/science and citizen science projects. The Making Sense Team comprises artists, critics, programmers, researchers etc. with expertise in CS as well as in technology for social innovation.

Joint challenges and benefits

The interaction of artists and scientists is not free from friction and neither is the interaction of artists with citizens. There can be scepticism concerning the role of art in science. Also, artistic interaction with science has been misunderstood as illustrating science for citizens. This can be avoided by clarifying the artistic focus of the interaction. In more innovation-focused interactions, care should be taken not to instrumentalize the arts solely for commercial exploitation. It is important to maintain an artistic stance to benefit most from the artists' creativity even when the penultimate perspective is an innovation.

Scientists are sometimes less interested in reaching a broad public; but most art is directed at the public. Artists therefore **provide an interface** that science may be lacking including methods, spaces, and audiences, e.g. science galleries and media contacts.

It is a huge challenge that **art and science funding are often strictly separated**. They are sometimes considered opposites defending their respective territories. Therefore, funding for art/science interaction is limited, despite the relatively small amounts that could stimulate interesting art/science interaction. Similarly, citizen science actions find it often difficult to attract funding for an artistic perspective.

Art/science/technology interactions will be increasingly relevant for policies looking for **novel ways to create**

impact from research. Innovation managers from both industry and universities increasingly take interest in the outcomes from art/science interactions. The interest of broad audiences may serve as an indication of directions for product and service innovation. Also, artists interfacing with science and a broad public have in the past proven instrumental as **early adoptors of scientific results and as early-stage innovators**.

CS and art/science both have potential to **critically discuss and contextualize new developments**, e.g. in artificial intelligence, genetic modification, environmental impact of new materials etc. In this way, CS and art/science discourse reinforces Responsible Research and Innovation (RRI) and **responds to diminishing societal trust in science**. Art/science can improve access to scientific results, increase transparency and foster reflections of scientific research.

CS and art/science can **facilitate knowledge transfer between science and society to stimulate innovation.** For both approaches it is common to cross disciplinary boundaries and contribute to knowledge integration between scientific domains. This can bring together varied kinds of expertise and enable unique research endeavours.

Case study 3: From art exhibition to living lab

https://melbourne.sciencegallery.com/

Science Gallery Melbourne was created to explore collisions of art and science in an effort to reach out especially to young people aged 15-25. The Gallery organizes dedicated exhibitions and invites artists to take inspiration from science. Artworks are typically physical objects. The gallery attracts more than 250,000 visitors per year. This in turn creates an opportunity to study the user interaction and user-generated feedback, thereby turning a museum space into a living lab. This then feeds back into the scientific process.

Science Gallery Melbourne is a member of Science Gallery International, a Global Science Gallery Network in partnership with leading universities worldwide. Each node shares the common mission: to ignite creativity and discovery where science and art collide.

Current Status & Recommendations

Despite many potential synergies, CS and art/science are often envisaged as separate endeavours. Where art/science initiatives exist, they often do not take into account the full cycle from outreach to citizens as drivers of science and research. This implies the following recommendations:

Art/science and citizen science dialogue

- Share citizen science results with creative audiences, for example at public art/science events and exhibitions.
- Establish an open dialogue and invite creative minds including artists to contribute based on their own creative experiences and work.
- Create open physical spaces for art/science/citizen interaction. This includes exhibitions, but also

living labs where art from science creates scientific interaction based on feedback from citizens.

- Inform scientists, and engineers about the potential benefits of art/science interactions for reaching out to citizens and thus gaining public support.

Inclusion & empowerment

- Expand the involvement of CS volunteers beyond data collection by opening all stages of the art/science concept to participation and enabling more co-creation of research results and works of art.

- Promote global-level dialogue and cooperation between citizens and artists while at the same time increasing local awareness through exhibitions or round tables to broaden public interaction.

- Inform industry about the potential benefits of CS and art/science interaction for innovation and the early adoption of new technologies. These advantages range from the creation of durable artworks that support sustained dialogues to the power of artists to co-create innovation in cooperation with citizens and novel feedback loops from artistic interation with citizens to research.

Education

- Include art/science training in research education and training on current artistic practices.

- Ensure means for science education and communication to accompany art/science initiatives and vice versa.

- Build CS and art/science concepts into teacher training.

Funding

- Increase and diversify the opportunities for small seed funding for the involvement of artists in CS projects. Currently, even comparatively small amounts can trigger interesting art/science cooperation.

- Aim to overcome the current separation of art funding from science funding. Consider the full spectrum of artistic contribution to and involvement in scientifc processes and their impact on the public including citizen scientists.

Further research and discussion

- Support research to improve our understanding of the art/science interaction and its relation to citizens and its impact on innovation.

- Policy makers should take advantage of the specific role that artistic interaction with science plays in reaching out to broad public audiences. Art is inherently communicative. It serves to establish critical discourse. Investments in art/science usually imply investments in public communication of science.

- Recognise and support the integration of CS and art/science as or within research infrastructures. A few large research infrastructure organizations run programmes for artist residencies. This should be expanded to smaller organisations including universities and public research institutes.

- Improve our understanding of creative processes in both artistic and citizen interaction with science.

- Promote opportunities for exchange between researchers, artists, engineers and a broad public in order to detect and address adverse effects as well as opportunities.

Conclusion

The concepts of citizen science and art/science both have long traditions, but are currently undergoing significant change. Some synergies between the two are evident: artistic practices and citizen outreach actions require a high degree of openness and both rely on critical reflection of current developments at their core. However, joint approaches to citizen science and art/science practices are still in their infancy. We should tap into the potential for involving citizens in art/science activities and for expanding artists' involvement in citizen science.

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Colophon

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