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Art and science in the UK: a brief history and critical reflection

Charlotte Sleight, University of Kent; Sarah Craske, University of Kent/SPACER.

Abstract

During the first decade of the twenty-first century, a conjoint activity, 'SciArt', was constructed, whose supposed interdisciplinarity very often shaded into a species of science communication. In this decade, discussions about the complementarity of art and science were conceived in terms of epistemology, notably the qualities of imagination and curiosity. Having briefly established this historical background, this paper moves on to discuss how, during the current decade, Art and Science (A&S) discourse has altered due to a number of changes in the cultural politics of both its constituent fields, emerging as a 'transdiscipline' characterised by 'creativity'. Eighteen in-depth surveys with leading practitioners in A&S form a substantial part of the research material. The paper examines, in large part through their critically engaged responses, what the disciplinary, economic and cultural implications of this changed discourse may be. Though potentially angled, at times, towards the solution of so-called 'wicked' problems, transdisciplinarity also sacrifices the specific critical expertise of art, fetishizes tech at the expense of science, and selectively ignores institutional problems inherent in funding and power structures.

1. The first decade of A&S¹: SciArt and its epistemology

Artists have engaged with science for centuries, exploring theories of perspective, colour and perception contemporary to their work, to name but three areas of synergy. Since World War Two and the emergence of 'Big Science' – science as product of the military-industrial-academic complex – the terrain has shifted. Not only have artists put to work concepts and materials *from* science; they have also taken as theme and topic the claims and cultural position of science *as a thing in itself*. In the UK, the Festival of Britain (1951) was the platform for an earnest and optimistic alliance of the two fields. Its artists drew on the latest and most advanced chemistry, biochemistry and physics; yet what they produced was decorative and democratic (Forgan, 2003). Such a spirit also pervaded the Independent Group, founded shortly afterwards. This too sought an art that was premised upon public legibility, engaging and mediated by empirical matters of structure, commerce and consumption (Alloway et al, 1990).

At the same time as engaging technologically-mediated mass-culture, however, artists began to critique it: a ludic and ironic tension characteristic of postmodernism. Artists in the US were particularly focused on such topics and themes. 'Tech art' was a recognised term by the 1960s (Porter, 1971, xiii) while 'Experiments in Art and Technology (EAT)', founded in c. 1966 by a group of engineers and artists (Candy and Edmonds, 2012, 8-11), pushed its boundaries still further. Artist and physicist Bern Porter came to prominence in this milieu, producing a playful yet highly critical engagement with science qua progenitor of modern material culture. Porter in fact coined the term 'SCIART' in the late 1960s (along with many other similar terms, such as 'SCIPHO', science

¹ For reasons that will become clear, we regard A&S (Art & Science) as a term preferable to SciArt. We employ the latter only where echoing the language used by historical actors in our account.

photography and 'SCITHE', science theatre – see Porter, 1971). His portmanteau term, reminiscent of the verbal play of science fiction fans, wryly invoked an art that was supposedly superior for its new, all-improved and modern nature. Yet, at the same time, Porter was aware of the shortcomings and bellicose impulses of science within the Military-Industrial-Academic complex, quitting his job as a physicist and leaving for Australia (hence his book's title, *I've Left*).²

'SciArt' as a term in its own right re-appeared more-or-less abruptly in the year 2000 (e.g. *New Scientist* vol. 167, 14). There is no indication of appropriation of the term from Porter, and indeed the biologically infused work that characterised British SciArt of the late twentieth century was quite different to his oeuvre; the term seems to have re-emerged by coincidence. The most significant instantiation of SciArt, in the UK at least, was through the Wellcome Trust's Sciart [sic] programme (1996-2006). The first call for ideas was launched at the end of 1996, eliciting 225 applications, of which six were successful (Wellcome Trust, 1998). The UK Branch of the Calouste Gulbenkian Foundation had a shorter programme supporting early R&D linking the two fields during the same period (Ede, 2002, 65). Altogether the Wellcome Trust funded 118 projects at a total cost of nearly £3M (Glinkowski and Bamford, 2009, 17), an average of approximately £25K per project. It went through several phases in terms of the type and scale of projects supported, and in terms of organisation: from 2000-2002 it operated as part of a funding consortium that included the Arts Council of England (as it then was), the Scottish Arts Council (as it then was), the British Council, the Calouste Gulbenkian Foundation, and the National Endowment for Science, Technology and the Arts (NESTA).

Most of Wellcome's beneficiaries were relatively little-known artists (Craske, personal communication), and as several commentators have pointed out (Born and Barry, 2010), this early phase of A&S was closely connected with the project of science communication. There were good reasons for this. During the late 1980s, leading institutions in British science had diagnosed a lack of public knowledge about science, fearing that this was bad for state funding of research and for democracy in general (Bodmer, 2010). The Committee on the Public Understanding of Science (COPUS) was founded in response; its final chair, before it was reconfigured in 2002, was a former Director of the Wellcome Trust, Bridget Ogilvie (James, 2016, 114). Things got worse for the scientists, however. Radical scepticism grew in the public sphere: outspoken suspicions were expressed concerning vaccines and genetic modification – both topics of direct concern to the research wing of the Wellcome Trust. Moreover, scientists came under apparent attack from the humanities, whose scholars accounted for scientific 'facts' through a process of social and discourse construction. These so-called 'science wars' (Sleigh, 2010, 196-199) increased the perceived need for science PR.

We have not been able to find evidence of COPUS funding arts projects directly but we note the overlap of personnel between it and the Wellcome Trust; the latter was the single most important funder of science and art collaborations during the science wars and beyond, defining the ideological contours of SciArt, and through SciArt exemplifying what a collaboration in A&S might mean. An early description of The Wellcome Trust's scheme stated that 'The SCI~ART competition aims to interest people in medicine using art as a medium' (Wellcome Trust, 1998). The SCI~ART

² See also G. Kepes on MIT interdisciplinary art/science of the 1960s (and Gombrich). Also go back to earlier Kemp e.g. *The Science of Leonardo*. Despite the blurring he constantly reasserts the difference between science and art. Later in *seen/unseen* he tries to mingle but unsatisfactorily. See also Stephen Wilson.

programme played its part in the Trust's hoped-for creation of a scientifically well-informed public that would support the progress of biomedical research. Alternatively, or additionally, it aimed to raise the ethical issues whose policy resolution this audience would need to buy into, in order fully to support it: 'Sci~Art will fund projects producing work that simultaneously promotes the public appreciation of medical science and encourages innovation in the visual arts' (Wellcome Trust, 1996).

The Wellcome-commissioned report (2007) evaluating the programme – on the whole a multi-vocal and candid piece of work, expressing both positive and negative views – submerged these original aims in its three areas of analysis. First, it asked, was the art produced of good quality, and had artists had their practices developed through the scheme? A second set of questions about science did not concern, in a symmetrical manner, the quality of the science produced, but rather the extent to which scientists had been drawn into 'public engagement'. Third was the public, and here the assessment was closest to the decade-earlier articulation of the scheme: 'to evaluate the impact funded projects had on the public's engagement with science, in terms of audience reach' (all points from Glinkowski and Bamford, 2009, 25). A strong sub-narrative also emerged from the report, congratulating the scheme on having picked up on an interdisciplinary 'zeitgeist' (28), and through acting as an early sponsor of this trend, establishing SciArt as a 'brand' (28). By side-stepping the original aims of the scheme, and by discussing SciArt as though it were a pre-existing domain in its own right, the report performed a neat sleight-of-hand. Rather than representing SciArt as something that *emerged* from a science PR project and hence was connected to it necessarily, it was presented as a cultural venture *sui generis*, with the ability to bring cultural legitimisation to science.

The explication of this cultural legitimisation went well beyond the bounds of the Wellcome report. Overall, it can be characterised as a discourse of complementarity. Epistemology was mooted as the feature common to both science and art, with imagination and curiosity the two leading contenders to fulfil the role.

Siân Ede, involved in early A&S as Deputy Director at the Calouste Gulbenkian Foundation, London, and Director of its Arts Programme spoke warmly and inclusively of the complementarity of both of SciArt's constituent disciplines in society:

... in our clever, curious and materialist world 'art' is as vital to our existence as 'science'. Visualising, abstracting, imagining, inventing, pretending, storytelling, re-presenting and ceaselessly reinterpreting things are as important ... as rational discourse (Ede, 2004, 2).

This reassuring and conciliatory statement is noticeably a product of the science-wars. It echoes the unintentionally Dickensian quotation employed by the Wellcome Trust at the head of its press release announcing the SCI~ART programme: 'There is no science without fancy and no art without facts' (Wellcome Trust, 1996).³ This trope continues to the present: one of our respondents (see below) explained the importance of daydreaming for science: 'Would Alexander Fleming have noticed the importance of that strange mould growing on his Petri dish ... had it not been for his artistic character?'

³ Though the quotation is attributed to Vladimir Nabokov, to British readers it may more naturally summon the unhappy fact/fancy dualism that divides and structures Dickens's *Hard Times*.

Others take the naturalised, imaginative resonance of art-thought and world still further. The art historian Martin Kemp (2016) argues that our brains contain ‘structural intuitions’, fundamental perceptual and cognitive mechanisms common to both science and art. The reason why these intuitions work, he suggests, is that the same fundamental forces that shape the universe also shape our cognisant minds.

Some articulations of complementarity from the art world of the 1990s betrayed a sense of inferiority in relation to science (whether personally felt, or simply recognised in differential cultural valuing of the two fields). The 1996 Joseph Beuys Lectures, for example, featured several speakers who suggested that artistic methods and perspectives had been vindicated by recent developments in non-mechanistic physics (such as quantum or relativistic phenomena) (Fleming et al, 1997). None of them, with perhaps the exception of Cornelia Hesse-Honneger, suggested that science might be vindicated by art.⁴

Curiosity has been another key trope conventionally used to connect art and science. Indeed, the Wellcome Trust has placed curiosity at the centre of its brand, making its museum ‘The free destination for the incurably curious’. Besides possessing a pleasing interior rhyme, the phrase makes an Ouroboros of the disciplines. Curiosity is usually regarded as a humane quality, not an organic one. By associating it with curability (or the lack thereof) in this catch-phrase, however, it is (wryly) transformed into a disease – claimed for medicine. At the same time, the museum’s presentation of disease is intended to engage the humane qualities of the viewer – the task of the ‘medical humanities’, also promoted by the Trust. The Hayward Gallery, under the curation of Brian Dillon, made *Curiosity* the theme of a touring exhibition (2013-14). Dillon, citing the sprawling cabinets of curiosity of the early-modern era, made no attempt at didacticism in his assemblage (Dillon, 2013, 9) and at least one reviewer saw the show as not so much questioning as dissolving entirely the boundaries between art and science (Sterling, 2014, 1). Nevertheless, curiosity often remains an instrumental quality in the service of science. Search for quotations about it online and you will find an ocean of anodyne, inspirational landscape photos overlaid with the words of Einstein. Specific examples include the naming of the 2012 NASA Mars rover ‘Curiosity’ and the description of the Large Hadron Collider by CERN’s former director as ‘continuing a tradition of human curiosity that’s as old as mankind itself’ (Ball, 2013, 1). A recent project by Phillips et al (2015) aimed to encourage ‘... curiosity as a way to wellbeing’.

However, it was not long before a critical strand in A&S became evident. (To its credit, the Wellcome report acknowledges it (Glinkowski and Bamford, 2009, 30)). Ede was again articulate on the matter: ‘there are some artists whose works engage in a complex, non-simplistic way with the political and ethical consequences of science’ (2002, 67-8). Some fifteen years later, this restriction of criticism to after-the-fact application of science looks just a little too obedient, albeit unwittingly, to the Wellcome project. O’Riordan (2012), in her book about genomics, probes the double bind whereby even critical artistic engagement can contribute to scientific hype and enhance its power in the world. The artistic critique of SciArt (the first funded wave of A&S) – shared by this paper’s authors – thus revolved around the accusation that art was subordinated to science in the pursuit of communication. The lightweight epistemological justifications that were given, concerning the

⁴ In her lecture, Cornelia Hesse-Honneger makes a strong eco-critical case for scientists’ need to accept the observational skills of insect-specialists working outside of academia, and most especially to take on board the alarming evidence of mutation caused by human activity that her artistic research has revealed.

complementarity of art and science, were not strong enough to surmount their institutionalised asymmetry.

2. The second decade of A&S: Constructing and institutionalizing transdisciplinarity

Over the past decade, new cultural-political factors have come into play regarding A&S. For one thing, there has been a maturation of the critique of deficit models of science communication (Bucchi, 2008). (Deficit models propose that the public fails to relate positively to science because it does not know enough science, and that the role of science communication is to fill them up.) There has also been a recasting of science within the domain of technology, rather than vice versa – and a changed political-economy of science that has come in its wake (perhaps best exemplified by the feverish reaction to the development of graphene as a wonder-substance). Finally, awareness of the seriousness of climate change has intensified.

These changes have been accompanied by a trend to consider A&S as a ‘transdiscipline’ rather than a relationship of complementarity. Moreover there has arisen a new concept to epitomise the link between art and science as a matter of creativity. The word is used twelve times in the 134-page Wellcome report – its publication was early in the fashion for the quality – occurring in two precise contexts of use. The first, accounting for seven of these, refers to permission granted to scientists by the scheme, to daydream, explore and develop: to play at being an artist. Scientists reported with satisfaction that ‘working with an artist had enabled them to rediscover a creative dimension that had, to some degree, been “sacrificed” because of the professional protocols and conventions that were involved in being a scientist’ (Glinkowski and Bamford, 2009, 10). The interaction between the two disciplines, mediated by ‘creativity’, brings cultural capital to science in the context of the long tail of the two-cultures debate. Creativity is a sort of epistemology-lite that is used ubiquitously to describe the working method of both science and art. Rarely found in professional artistic discourse, it is nevertheless used promiscuously in academic articles, popular books and blogs, finding particular favour within education theory (Robinson and Aronica, 2015).

‘Creativity’ was coined in 1659, and denoted an entity of ambiguous virtue for its first three centuries of use.⁵ It was acceptable or even laudable when attributed to the Deity, but symptomatic of undisciplined splurging when attributed to a human. This distinction haunts the recent compilation *Art, Not Chance* (Allen, 2001), commissioned ‘in order to demonstrate that art is not the consequence of a lightning-streak visit from some baleful muse, nor the product of a warm and wonderful process called “creativity”, but comes from ... working very hard’ (ed. Turney, 2003, 7). Banaji (2008) provides an excellent anatomisation of the overlapping and often conflicting rhetorics of ‘creativity’ that have been adopted over the past twenty years or so, showing how it has been used to invoke craft skill, as opposed to the supposedly rarefied quality of artistic genius. It has thus attracted praise on the one hand for the democratisation of art, and opprobrium on the other from guardians of artistic elitism. Creativity has also implied the production of a material artefact, or something useful. This productivity – historically collocated with the emergence of computers and later digital technologies – connects with neo-liberal notions of the knowledge economy (see Landry,

⁵ Ball (2013, vii-viii) hints at a parallel history for ‘curiosity’, yet to be fully investigated.

2000; and Seltzer and Bentley, 1999, for two straight-faced endorsements). The Wellcome report's second usage of 'creativity' occurs within this last frame, in a section entitled 'SciArt and innovation'.

According to Google Ngram results (figure 1), use of the word 'creativity' increased dramatically in the latter part of the twentieth century.

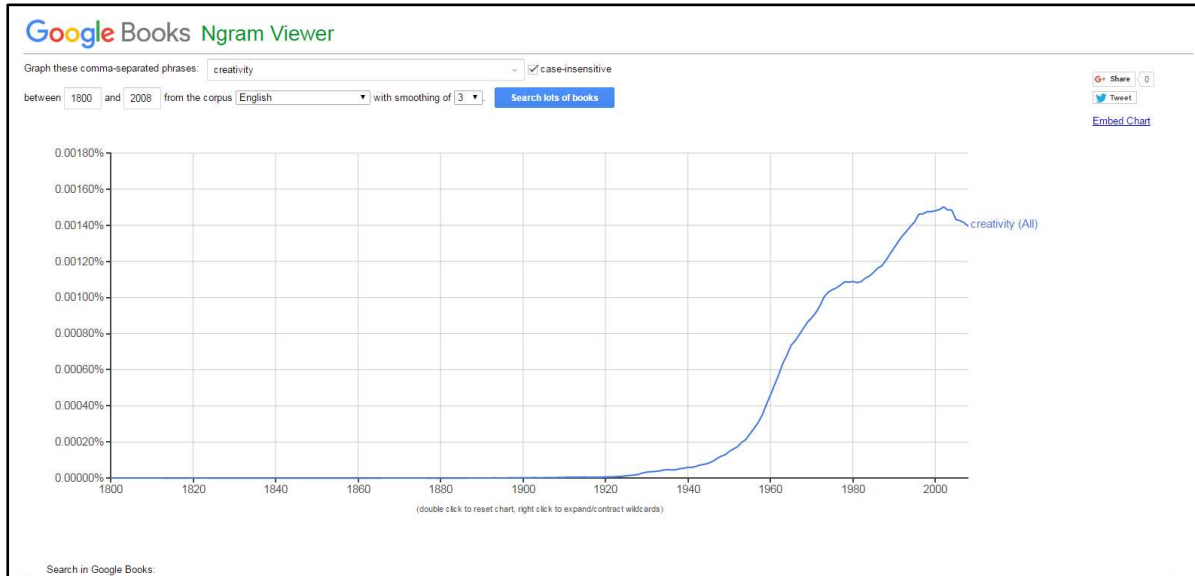


Figure 1: Historical frequency of usage of the term 'creativity'.

As Calver (2013) has demonstrated, 'creativity' arose in response to the two-cultures debate of the early 1960s. F. R. Leavis, in his response to C. P. Snow, had slammed the pretensions of scientists to artistic merit or participation. The biologist Peter Medawar spearheaded the Royal Society's response, mobilising Karl Popper's recently-translated *Logic of Scientific Discovery* (1959 [2002]) to do so. Popper, now best known for his method of falsification, was championed by Medawar for the scientific stage prior to refutation, that is, of conjecture. Popper wrote:

... every discovery contains 'an irrational element', or 'a creative intuition', in Bergson's sense. In a similar way Einstein [says]: 'There is no logical path ... leading to ... [understanding] laws [of the universe]. They can only be reached by the logic of science intuition' (Popper, 2002, 8-9).

To place this aside at the centre of Popper's philosophy was a perverse reading; nevertheless it was a lifeline to Medawar and other scientists. 'Creativity occupied the central position in the Popperian scheme of thinking: an inspiration, a flash of insight' (Calver, 2013, 9). It placed scientists on, potentially, the same sort of pedestal as Keats or Turner, rescuing them from Leavis's charges of ignorance, clerk-ery and hubris. Popper's rejection of authoritarianism, brewed in the context of anti-Semitic persecution and Stalinist purges, became a rallying-point for neo-liberals in the epoch whose opening coincided, more or less, with the two-cultures dispute.

Meanwhile, creativity was much in vogue in educational theory of the 1960s and 70s. Here, it was wielded by psychologists and psychiatrists (whose discipline was not at all congenial to Popper), signifying a break from tradition and an affirmation of individualism, even within science (Sullivan and Taylor, 1967, 32-34). It gave birth to the Science Center movement, notably the San Francisco

Exploratorium at the Palace of Fine Arts(1969), whose experiential approach to science emphasised its connection to the arts, similarly conceived (Ogawa et al, 2009). Like so much from that era that, at the time, seemed a laudable antithesis to authority and conformity, this approach to creativity can with hindsight look like an unfortunate nurturing of the individualism that underpins the neo-liberal economy. Along with the incorporation of Popperian philosophy, this suggests an ideological strand in the recent history of 'creativity', present from the 1960s. Creativity has taken its place in a neo-liberal discourse of science, ungoverned by the state and yet magically, creatively, in service of the economy.

Today, no area of science appears to fulfil this neo-liberal aim more effectively than the emergent category of 'tech': science that produces, or exploits, digital and cloud-based technologies. Edwards' book *Artscience* is an excellent exemplar of the new collaboration between the fields, mediated by 'creativity'. Today, creativity is embedded in the hybrid of globalised business and philanthropy exemplified by TED (Sleigh, 2013). On its website TED offers a playlist of talks collected under the theme of 'creativity'. 'Where does creativity come from?', it asks. 'How can you nurture your own? Watch TED Talks from creative people like Steve Jobs...'.⁶ Artists (who, as it happens, are pretty much Mac users to a person) tend to take a more critical view on the utopian potential apparently embedded in creativity and tech. Indeed, at the very time that creativity began to be bandied about in science, the teaching of art began to insist upon more academic rigour in discussing such things. Art colleges began to give bachelor's degrees in the 1970s, an indication of the nuanced understanding of creativity and related concepts that the study of art was supposed to instil in its practitioners.

Skimming through recent papers in the leading art & science journal *Leonardo* reveals amongst artists a sceptical if not combative view of big business and its ability to solve the present environmental crisis. Instead of 'creativity', 'transdisciplinarity' has emerged as a term to capture their practice in conjunction with science ('transdisciplinary' picks up 381 unique article and review hits in *Leonardo*, for instance). The term is defined by Darbellay (2015), who gives it three senses. One of these is transdisciplinarity's orientation towards problem-solving. Another is its commitment to including 'actors from outside the scientific field' in research processes. Because of this quality, Rosendahl et al. characterise the output of transdisciplinary research as "'socially robust" rather than classical "scientifically objective" knowledge' (Rosendahl et al, 2015, 18).⁷ In its 'pragmatic, participative and applied' nature, Darbellay's transdisciplinarity resembles tech-based creativity: but not in tech-fetishism, or, necessarily, in sources of funding.

The embrace of transdisciplinarity is also connected to a revival of the 1960s/70s term 'wicked problems' (Rittel and Webber, 1973). Wicked problems are those that are highly complex (typically a mixture of social and natural factors) and difficult to define; their nature may not become apparent until after they have been solved. Artists preoccupied by the current ecological crisis (Brandon Ballangée, Helen Mayer Harrison and Newton Harrison, William Myers) have often reached for the terminology of the 'wicked problem' to describe it, and see something like Darbellay's transdisciplinarity as the kind of multi-pronged, democratic and critical method as the only kind of approach likely to produce any kind of solution. About the role of technology in all this,

⁶ <https://www.ted.com/topics/creativity> last accessed 26 July 2016.

⁷ One is obliged to observe that the central point of STS is that scientific knowledge has *always* been characterised by social robustness; the problem is merely which people are permitted to speak for 'society'.

and the desirable source of funding, artists are less explicit. Nor do they necessarily endorse the ideological entanglements that come from the Research Councils' yoking of 'multidisciplinary' methods in 'priority areas' (<http://www.rcuk.ac.uk/research/xrcprogrammes/>). Artists do not typically see themselves as goal-orientated towards the solution of wicked problems, as the Research Councils demand, but may identify transdisciplinary space as a potential site in which such problems can be addressed. Such spaces are being created in the specialist A&S Masters programmes which are just now appearing around the UK: 2011 at UAL; 2016 at Liverpool John Moores.

One final trend to highlight in the last decade is the rise of BioArt. Seemingly coined in 1997 by Eduardo Kac (Geldorp, 2016, 5), BioArt presents as the younger, more rebellious sibling of SciArt. Even the portmanteau word works better than SciArt, with the first particle, Bio, clearly a modifier of Art, the main business. O'Riordan calls it the 'ethical or tactical' alternative (O'Riordan, 2012, 71), meaning that it does not fall in with science so much as challenging it. (However, Geldorp's sceptical account suggests that, with the exception of the VIDA Artificial Life International Awards, competitions in the field are still orientated towards science communication.) BioArt is often more pugnacious than its predecessors in its epistemological stance, using science against itself. Practitioner Suzanne Anker writes: 'Bio Art employs the tools and techniques of science to make artworks' (Myers, 2015, 7). Meanwhile, William Myers moves in to claim the realm of 'nature', usually owned, via objectivity, by science: 'Bio Art is a practice that ... addresses the changing nature of biology's meaning through its output' (Myers, 2015, 8). BioArtists often make their own lab-spaces, sometimes in overtly unlikely spaces such as the woods; when they have been brought into conventional laboratory spaces, via well-intentioned projects of democratisation, things have not always gone well (Davies et al, 2015). Perhaps most strikingly of all, BioArtists sometimes use the tech-word 'hacking' to describe their practice. This word is, however, ambiguous; by 'hacking' nature, are they making a sceptical challenge to the ideological entanglements of professional, big pharma-funded science, or falling in with its tendency to commodify life? Whilst the former might seem ideologically refreshing, one should not forget that populist challenges to scientific expertise have taken a darker turn in recent years.

3. Artists' perspectives

As part of the project *Metamorphoses*, we (artist Craske and STS scholar Sleight) created an in-depth survey for practitioners in A&S, designed to uncover the realities of their experience in the field. There were 25 questions in all, grouped around the following themes: (1) Aims of SciArt [sic]; (2) Disciplinarity; (3) Funding; (4) Power relations. We were keen to give space for artists to discuss the expected epistemological questions if they wished to do so, but more importantly wanted to try and uncover some of the practical and social issues involved in A&S practice, such as money, power and authority, in the current phase of transdisciplinary institutionalisation.⁸

Eighteen artists were involved; these were selected for their pre-eminence in the field of A&S (and as such are an international selection, despite the British focus of the rest of this paper). Over 80 percent of them are or have been aligned with academic institutions around the world, whether

⁸ The quotations from the survey responses that follow have been silently tidied for minor errors of typing and grammar. Any significant changes or interpretations are marked with square brackets in the usual manner.

universities or independent scientific research organisations. Some have become permanently embedded within academic departments related to their research, and other have formed more informal relationships. All are highly successful at applying for and receiving public funding, either through the institution with which they are aligned, or independently. Respondents were informed that their responses would be anonymised, including details of projects where these might be recognisable. There is strong reason to believe that the non-institutional nature of our survey, combined with the fact that the approach was from a fellow practitioner, might produce more candid results than those obtained by the Wellcome Trust in its evaluation, notwithstanding its good-faith attempts to invite honest feedback. A number of themes emerged, some that fitted in with the grouping of the questions, and others that emerged in their own right, cutting across the themes we had anticipated. These themes are treated below: research, disciplinarity, funding, and power relations.

Research

The first theme was the nature of research itself. Here, there was a remarkable interchangeability with scientists' thoughts on the topic.

Our respondents overwhelmingly indicated that their engagement in A&S was not outcome-orientated. 'I am not trying to answer any questions really, I make art' (respondent 2). 'I never consider myself to be a true researcher, inasmuch as I don't set out with a question' (respondent 13). This was set against a belief that scientists are often results-orientated. 'Sometimes scientists want to know what the outcome is going to be at the start, and they need to gain confidence that it is about the journey' (respondent 18). Funders were criticised on the same grounds: 'It would be nice if funders funded an artist to practice rather than a specific outcome' (respondent 11). There was a particular concern that 'research should not be concerned with coming [up] with new inventions etc.' (respondent 8). This is interesting given the techno-curative tendency of much current transdisciplinary hype. The respondent added: 'these may come but should not be the reason for the research'.

'This is a wider problem of current society', observed respondent 13, 'that [we] have to justify activity based on monetary return rather than other values'. In a current UK climate that demands proof of research 'impact', our artists make strikingly common cause with scientists fighting to maintain 'blue-skies' or 'fundamental' research (Poppy, 2015). Economically justified funding is the common enemy for artists and scientists, often expressed as a similar politics. (There was just one minority report, with one respondent stating that art is poor at explaining its socio-economic value. Curiously, this artist was by his/her own account 'bad at getting funding'). Several respondents explicitly or implicitly expressed a vision for a long-term programme of basic research in A&S, even, indeed, claiming that collaborative research is meaningless unless it exists on that timescale. It was lamented that 'short term [A&S] projects with tangible outcomes will be favoured over more long term basic research' (respondent 4).

Those of our respondents who explicitly compared themselves to scientists in terms of research agenda believed that they are even more radical than their comparators, in that they embrace questions, rather than seeking answers per se (the latter being perceived as an activity proper to science). Interestingly, there is a persistent articulation of 'the scientific method' that constructs scientists in a similar manner. Karl Popper's notion of science as an unending mission of falsification

has proved appetising to many scientists seeking to avoid hubris in the post-atomic age. 'I never claim to find the truth' has played well in this context, perhaps even more so in the current era of fundamentalisms (Dawkins, 2013, 184-9). The one artist amongst our respondents to cite an STS scholar as inspiration or justification of their results-eschewing method named Paul Feyerabend. This was an accurate and well-informed academic contextualisation for their artistic practice.

Another respondent accounted for their work as representing the act of observation itself: 'Coming from a photography background, the experience of working with living materials [has] changed my artistic trajectory from representations into presentations' (respondent 5). This strong claim bears comparison with Daston and Galison's account (2007) of scientific objectivity.

Disciplinarity

One of our respondents reacted very strongly to the term SciArt. 'I hate the term sciart [sic]!!' (respondent 14). One is reminded of George Levine's discussion of the apparently 'innocuous copula' joining 'literature and science' (Levine and Rauch, 1987, 6); if this 'and' is evasive, how much more troubling the abrupt conjoining of the terms science and art. Other respondents were ambivalent at best about the discipline. One consistently referred to 'Artsci' throughout their answers, despite the use of 'SciArt' in the questions. The only direct clue as to the reason for resistance to the term came from respondent 13 who said 'By the way I hate the term SciArt – it was a funding stream led by a consortium in the 90s and I thought we had escaped it!' The respondent goes on to emphasise their independence from this source of funding by describing their financial reliance on a mixture of 'commissions, paid exhibitions, speaker's and workshop fees'. The Wellcome Trust too recognised resistance to its own term, stating in its report:

A number of interviewees expressed reservations about some of the associations that were perceived rapidly to have accrued to the label 'SciArt'. There was a sense that the brand had transcended its original function as the descriptor for a funding programme and had assumed much wider currency as a shorthand term (often incorrectly applied) to describe a genre of arts practice (Glinkowski and Bamford, 2009, 29).

Our artists were also ambivalent about the term transdisciplinarity, though less vehemently so. There was a unanimous lack of interest in what word is best used to describe working across disciplines – multi-disciplinarity, interdisciplinarity or transdisciplinarity. 'These are not well defined terms that mean working together in various ways. I take them to mean that and ... do not worry about it' (respondent 2). 'The differences between these terms remain unclear to me ... I ignore these terms and their distinctions' (respondent 10). As a result, we have used the term A&S throughout this paper, except where referring to SciArt as it was explicitly thus designated.

Moreover, several respondents asserted the value of disciplinarity quite strongly. They saw a value and a uniqueness in their professional artistic practice, and extended the same respect towards science. But, as respondent 11 stated, 'An important question is the possibility (or not) for genuine "symmetrical" collaboration between artists and scientist. I've never experienced such a collaboration and I've not seen one elsewhere ...'. As more and more programmes for artists in residence are set up by major scientific institutions (such as University College, London or Biofaction), it will be interesting to revisit such comments in future.

The artists are positively inclined towards the political ideology built into transdisciplinarity, that is, its potential solution of 'wicked' problems. Several of them made reference to the environmental and climate crises facing the planet. However, several others articulated caution or outright scepticism that the political telos of A&S was actually achievable. 'I am suspicious of claims that any particular thing will "solve our global issues"' (respondent 6). Moreover they were cautious about making overly ambitious claims about the contributions that their own work might make.

Funding

Inevitably, complaints about the difficulty in obtaining funding, and the less-than-optimal level of funding, are widely distributed through our sample (c.f. Callard and Fitzgerald, 2015, 23). There was a specific quibble about the inability or unwillingness of scientific professionals to accept the technical costs entailed in the production of artworks. However, perhaps because we selected a successful set of practitioners, complaints about the availability of funding were not the main theme under the topic.

Much more interesting were the reflections on the effects of funding upon scientific and artistic culture. The first widely expressed opinion, relating to what has already been covered under 'research', was that there should be structures for the long-term funding of artists, better matching funding timescales with the timescale of natural research practice, and not artificially tethering it to results. 'I think the UK research councils should take a leaf from the EU's book and look at embedding artists within research for extended, open ended residencies' (respondent 14). 'There is inadequate understanding that artists are often working independently outside of academic or institutional support, and they need to have their base salaries supported' (respondent 9).

There was a widespread recognition that funding bequeaths an authority to its winners, even in tiny amounts. Respondent 11 recalled gaining their first grant in the 1990s: 'The important thing about the funding (£700) was that it gave me the authority as a 'researcher' to approach [internationally-known research institute].' Another artist said, 'I've never felt disadvantaged [due to my engagements with scientific practice], in fact quite the opposite' (respondent 9). Others commented on how A&S projects enhanced the fundability of science. Respondent 3 recounted a story in which adding an A&S component to a previously-rejected scientific project resulted in the award of a €10M grant.

Power relations

This last story indicates how power relations (Callard and Fitzgerald, 2015, 96-111) can cut both ways in A&S, though it is more usually seen by artists as unidirectional, with science having the upper hand. Respondent 6 had heard that there were 'structural biases favouring scientists and disadvantaging artists' in one trust that has administered A&S funding. This same artist expressed scepticism that there could ever be symmetry in A&S owing to the 'different career structures' that they possess.

Only one of our respondents had an initial training in science (Bachelor's degree) and it was notable that he/she was the only one to state explicitly that they drove the research questions in the lab. Others used the word 'privilege' to refer to working in science (in one case, in the context of 'failing' science at school). Still others had mixed feelings about their palpably 'exotic' status in the laboratory, or their 'celebrity status in science'.

Over and again, the respondents emphasise (in warm terms) the value of the personal relationships they have cultivated with scientists, and the quality of work that this has made possible. A discourse of hospitality underpins this; it is the offering of lab space that is valued. And yet a different question to the one that elicited answers about personal hospitality called up responses from several artists stating a desire for a 'lab of [their] own'. (Respondent 2 told a story about how they had accommodated their low priority for the use of the latest microscope in the lab hierarchy by developing a creative practice with an older model.) They also, in several instances, expressed a regret that scientists never enter the space of the artist's studio. Putting together all these responses, one is struck by the Derridean nature of the situation; what we have here is 'hostipitality' whereby any gesture of hospitality semiotically makes the point that it is conditional and might be withdrawn (Derrida and Dufourmantelle, 2000, 45).

A final issue raised in the theme of power relations between art and science is that of ownership. Universities contractually own the research of their employees, though in practice this is not always completely or rigorously enforced. However, artists perhaps have a stronger and more exact sense of ownership than most researchers, and were sensitive to the appropriation of their work. Besides the issue of ownership in a legal sense, there was also the issue of artistic integrity: a professional sensitivity to a modified version of the work being presented as theirs. The recipient of the £700 grant added of their new colleagues:

The only real difficulty outside of personal limitations in learning complex science has been in relation to ownership of the outcomes. This is partly cultural, the science world has evolved to share knowledge, predominantly through publishing. Problems arise when unique artworks are produced using assistance and technologies of scientific institutions. They have little understanding of how the art world works and so may believe they can do what they like with work you produce under their roof.

The artist described the resolution – apparently without disgruntlement about its asymmetrical nature – as an agreement to the institution's 'limited non-commercial use of images for publicising research and fundraising for their research in exchange for free use of their equipment'.

The issue about art being in service to science communication is still in evidence. Respondent 2 observes that art funding is for public access, whereas science funding is for behind-doors research. Respondent 16 represents the negative responses (about half), describing '... being approached by a lab who spotted a [relevant] research fund. The problem was ... they just saw it in terms of communicating their research'. The critiques about SciArt as science communication by other means still holds; the soon-to-open Science Gallery in London states that its exhibitions and events it aims 'all [have] scientific engagement at their core' (Science Gallery, 2016). Others of our respondents take a more optimistic view of the nature of the communication, describing scientists' attitude to their research transformed by collaboration; in some instances respondents explicitly designate this outcome as their communication work. Others still accept that they are being paid for communication, but believe that they are making the science more culturally complex – problematizing it – in the process. The recent trend for having artists in residence embedded in laboratories for long periods, allows more complex relationships to grow up between practitioners of the disciplines, and hence, perhaps, between the disciplines themselves.

4. Conclusion

The scale of our project was such that we did not have time for a second set of surveys symmetrically exploring scientists' feelings about A&S. Deciding what questions to ask scientists will be a tricky job; it is the nature of things that a person in a hegemonic position is not easily able to perceive the nature of the platform on which they stand. One could certainly construct a survey that probed motivation and timing in engaging artists: At what stage in the grant-seeking process was it considered? What institutional and career advantages was it considered to bring? Were there any disadvantages? We suspect that a little art in the right place is acceptable – even encouraged – for a scientist, whereas a career built around it may be severely limiting. In a vein more similar to the survey conducted with artists, scientists' experiences of collaboration will be of interest, including its impact upon their own practice, the sharing of space and time, and their degree of awareness of artists' contracts and IP expectations. Questions that are symmetrical in the spirit of our survey of artists would probe scientists' ease or unease at working with these exotic specimens from the world of art: does the long shadow of F. R. Leavis result in a guilty sense of cultural ignorance (a lack of 'artsiness') to be hidden or bluffed out?

In this paper we have traced the progress of A&S from an adjunct of science communication, validated asymmetrically with respect to science by loose epistemological claims about curiosity, creativity and imagination, to a field more fully articulated by its artistic practitioners as transdisciplinary. This transdisciplinarity, as pragmatically defined by UK Research Councils, holds the solution of 'wicked', typically environmental, problems to be its main aim; it implies the involvement of many stakeholders and downplays the importance of disciplinary expertise. But whilst open participation is held to be a good thing, the loss of their own disciplinary expertise is not uncontested by artists. Meanwhile, the tech-happy version of creativity, mirroring transdisciplinarity in many ways, does not altogether resonate with their practice, although the emergence of BioArt as 'hacking' suggests a certain embrace of the culture. The re-embedding of A&S funding in RCUK cuts against an earlier initial trend of philanthropic funding, forcing it to operate in an academic playing field that continues to make working practice difficult for artists.

At the other extreme of a co-option of art for science communication comes the uncompromising statement of Gilles Deleuze:

What relationship is there between the work of art and communication? None at all. A work of art is not an instrument of communication. A work of art has nothing to do with communication. A work of art does not contain the least bit of information. To the contrary, there is a fundamental affinity between the work of art and the act of resistance (Kaufman and Heller, 1998, 18).

Communication, for Deleuze, is the transmission and propagation of information; information is a broadly Foucauldian-disciplining set of 'order-words' which demand that one behaves in a certain way (in effect, as if one believed them). It is a tempting vision, to refuse communication altogether; but it is unrealistic. All acts of creation are acts of communication once they are viewed: this is the central message of STS regarding science (Secord, 2004).

What is also striking about the current state of A&S in the UK is the almost complete lack of critical scrutiny for its hybrid products in any kind of interdisciplinary (or transdisciplinary) setting (though

artists are very critically active amongst themselves). As discussed above, the Wellcome in its report did not evaluate the artistic quality of its sponsored outcomes. The Calouste Gulbenkian Foundation carried out a review of its scheme as a whole but this was not published and has not proved traceable.

Such reviews of A&S as are conducted tend to be on the celebratory side, as they are often prompted by the need to give a good account of the work to funding bodies or to quasi-governmental research panels. In the UK, Universities are subject to a Research Excellence Framework (REF, formerly Research Assessment Exercise [RAE]) review of their research quality about once every five years, upon which depends the extent of their future governmental funding. Evidence of research 'impact' has come to matter more and more in these assessments. One popular interpretation of this elusive quality amongst science departments has been communication, engagement and collaboration through art.

The same pressures have cut the other way; at the Ruskin School of Art, Oxford, then head of School Stephen Farthing created 'The Laboratory' largely in response to the first RAE in 1986 (Paul Bonaventura, personal communication).⁹ Although connections with science were arguably an organic part of practice at the School, a formal (and semiotic) connection with science was seen as a way to establish research credibility. An early project, co-conducted by Farthing

... examined how individual satisfaction with appearance during the course of [cleft palate surgery and care] has an important influence on wellbeing and whether the addition of artists onto a multi-specialty cleft team might further improve its clinical procedures (Reed, 2014).

This description is noticeably one-sided and lacking in evaluation from the artistic perspective.

We have been at meetings showcasing A&S projects and have been perturbed by the lack of critical discussion in the room (showcase, rather than conference or seminar, being the operative word). Neither of us can recall a single robust critique or a challenging Q&A session despite, on our respective parts, serious artistic and STS-based concerns about some of the projects exhibited.

Putting all this together with the artists' perspectives, one might posit a few potential cures for this lack of *critical* dialogue. Perhaps scientists should take a contemporary art history 101 as a pre-requisite for engaging in collaboration. What artists perhaps need to do (though Craske resists this directive) is be prepared to engage in some communication of their own; to learn to marshal words, on the right occasions (or sub-contract others to do so), to explain their research programmes to audiences unschooled in art history or criticism. One hopes that the new MA programmes in A&S will contribute to the development of this critical articulacy.

In order to facilitate artists' critical engagement with science (as opposed to co-option into a project of PR), thought might be given to creating neutral spaces – neither art nor science galleries – for transdisciplinary display and criticism, such that the rules of politesse that govern the home turf of either discipline do not pertain. Skilled curators, by intelligent and informed juxtaposition of objects

⁹ Other former art schools, as Candlin (2001) and Borgdorff (2006) have noted, began to evaluate their practice as 'research' following their re-definition as Higher Education Institutions subsequent to the Further and Higher Education Act (1992).

from 'science' and 'art' can actively set up critical dialogue. There are currently very few spaces like this; the Wellcome Trust has done the best job of providing one in the UK, with some excellent (and some mixed) results. University-sponsored spaces, loyal to neither the sciences nor the arts, would be an obvious alternative. Otherwise, pop-up spaces can be chosen, in order to evade the hegemonic critical spatial frames of science (or indeed of art). In an ideal world, artists would be supported more long-term in their basic salary costs via Universities (that is, multi-subject Universities), giving them an institutional foothold of intellectual autonomy from which to develop criticism and practice. In its uneasy relationship with economic value – whether mandated by state or philanthropic enterprise – academia is a congenially reflective home for artists and scientists alike. That same economic precariousness, and the rapidly changing environment of Higher Education, unfortunately makes such a solution unlikely.

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See also G. Kepes on MIT interdisciplinary art/science of the 1960s (and Gombrich). Also go back to earlier Kemp e.g. *The Science of Leonardo*. Despite the blurring he constantly reasserts the difference between science and art. Later in *seen/unseen* he tries to mingle but unsatisfactorily. See also Stephen Wilson.