



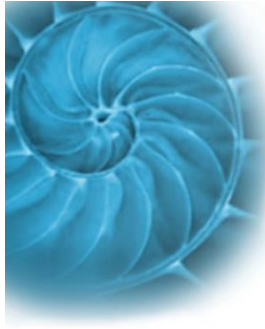
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Helix
research & evaluation

One Cell At A Time: public engagement with the Human Cell Atlas

Evaluation report

January 2022

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Helix Research and Evaluation

Contents

Executive summary	3
Summary report	5
1. Context and background	13
1.1. One Cell At A Time – public engagement with the Human Cell Atlas	13
1.2. Purpose, longer-term objectives and intended short-term outcomes of One Cell At A Time	14
1.3. Evaluation aim and approach	15
1.4. Overview of evaluation methodology	17
2. One Cell At A Time – inputs, activities, outputs and reach of the project	19
2.1. Inputs	19
2.2. Activities, outputs and reach	20
3. Outcomes for public participants	24
3.1. Attitudinal outcomes – changes to attitudes and motivations.....	24
3.2. Conceptual outcomes – increased knowledge and understanding	32
3.3. Capacity-building outcomes – new technical, artistic and personal development skills	42
3.4. Instrumental/behavioural outcomes – changes to behaviour, actions or practice	45
3.5. Connectivity outcomes – new connections and relationships.....	51
3.6. Affective outcomes – sensory, emotional and experiential responses.....	52
3.7. Summary of outcomes for public participants	57
4. Outcomes for HCA members	60
4.1. Attitudinal outcomes – changes to attitudes and motivations.....	60
4.2. Conceptual outcomes – increased knowledge and understanding	63
4.3. Capacity-building outcomes – new technical, artistic and personal development skills	64
4.4. Instrumental/behavioural outcomes – changes to behaviour, actions or practice	65
4.5. Connectivity outcomes – new connections and relationships.....	68
4.6. Affective outcomes – sensory, emotional and experiential responses.....	69
4.7. Summary of outcomes for HCA members	70
5. Successes and challenges: learning from the OCAAT programme	72
5.1. Successes.....	72
5.2. Challenges	77
5.3. Successes and challenges: summary of learning	81

6.	Conclusions: the longer-term impact of One Cell At A Time.....	83
6.1.	Summary of outputs, reach and short-term outcomes of One Cell At A Time	83
6.2.	Progress towards the overall aim and longer-term objectives	88
6.3.	Concluding comments	90
Annex A: One Cell At A Time - theory of change devised by the project team.....		92
Annex B: One Cell At A Time evaluation - logic model		93
Annex C: One Cell At A Time evaluation – evaluation plan.....		97
Annex D: One Cell At A Time evaluation - outcomes framework		99

Executive summary

- The One Cell At A Time (OCAAT) project aimed to bring about a cultural shift towards enhanced and sustained engagement with the Human Cell Atlas (HCA) across research and public communities. Funded by a research enrichment¹ grant from Wellcome, the project was operational across four regions of England, nationally and online, from July 2020 to December 2021.
- Managed by a central project team², with scientific leadership from the Principal Investigator/Co-Chair of the HCA³ and three senior HCA members⁴, OCAAT developed, co-created and delivered an ambitious and multi-faceted programme of art/science activities, events and resources in collaboration with a range of national partners, and four city-based teams of artists and producers/community engagement facilitators. The programme was evaluated by Helix Research and Evaluation.
- Over the lifetime of the project, 41 different events and activities (including multiple workshops, talks, discussions, sharing events, lab events, films, publications, online challenges, an online exhibition⁵ and the OCAAT website⁶) were delivered across 110 sessions⁷, leading to 1,067+ instances of engagement with public participants and 128+ instances of engagement with HCA members.
- The total reach (from July 2020 to end of December 2021) was at least 7,047 in person and online engagements with public participants and HCA members. This includes post-event and legacy engagement via recordings on the HCA YouTube channel and via the OCAAT website and online exhibition.
- The evaluation highlighted some key determinants in the successful delivery of the OCAAT programme: sustained strategic and financial commitment, including high level endorsement and advocacy, and investing in support for infrastructure as well as for programming activities; senior champions, demonstrating visible commitment to the public engagement initiative and encouraging engagement from researchers more widely; central coordination and curation, managing and providing direction for the programme of activities, and creating an environment in which relationships between researchers and publics can flourish; focus on depth of engagement, building relationships with public participants over time; use of an art/science approach to public engagement, providing new and diverse opportunities for engaging with science, and facilitating new entry points for publics who may not respond to traditional forms of science communication; partnerships

¹ <https://wellcome.org/grant-funding/schemes/research-enrichment-public-engagement>

² Paul Gibson, project manager (Wellcome Sanger Institute - WSI); Suzy O'Hara, curator (freelance); Laura Rothwell, PR and marketing (Crystallised); Samantha Wynne, HCA scientific communications manager (WSI); Luke Portess, webpage and registry administrator (WSI); Tracey Andrew, executive administrator (WSI); Louise Walker (Wellcome Genome Campus Public Engagement team); Paul Bevan, Mark Wilson, Matthew Waller, Stephen Robinson, Web, Core Bioinformatics and Software Action team (WSI).

³ PI: Sarah Teichmann, Wellcome Sanger Institute (Co-Chair of the HCA).

⁴ Work Package Leads: Muzlifah Haniffa, University of Newcastle; Krishnaa Mahbubani, Cambridge Biorepository for Translational Medicine, University of Cambridge; Anna Wilbrey-Clark, Wellcome Sanger Institute.

⁵ <https://www.onecellatime.org/exhibits/>

⁶ <https://www.onecellatime.org/>

⁷ This included where one event or activity was delivered more than once

with a range of external partners, extending the reach and depth of engagement with public participants; and development of online resources, enabling significant additional online reach after activities and events have taken place, and creating ongoing opportunities for legacy engagement post-programme.

- The evaluation also identified some challenges, mostly relating to the specific constraints of undertaking public engagement during a global pandemic which included: reduced reach in under-represented areas and groups due to limited internet and computer access, and lack of necessary support for virtual engagement; limited opportunities for participant recruitment in the absence of in-person approaches; limited communication between researchers, facilitators, and publics in the absence of face-to-face interactions.
- Other challenges raised by evaluation participants related to the size and complexity of the project, and ways of working with the HCA. These point to the need for future public engagement initiatives to: ensure that sufficient resources are available to match the scale and ambition of the project; extend timescales to allow relationships with publics and deeper engagement to develop; build in sufficient time for relevant sign-off processes from the start, so that engagement activity can proceed as planned; consider the merits of creating a social media presence for public engagement initiatives and develop policies and processes to provide a framework for such activity.
- The evaluation identified robust evidence of numerous short-term outcomes for public participants⁸ and HCA members⁹ who engaged with OCAAT activities. These included positive changes to people's attitudes, skills, knowledge, behaviour, connections and emotional responses in relation to the following core outcome areas: HCA research, tissue and organ donation for research; scientific (STEM) and medicine career pathways and opportunities; art/science public engagement.
- In terms of the longer-term objectives and overall aim of the project, the evaluation also found evidence of progress towards a cultural shift towards enhanced and sustained engagement with the HCA in the following ways: improved dialogue and transparency about HCA research; increased willingness amongst UK HCA members to seek out and value the opinions and experiences of patients and communities who donate to research studies; examples of more effective and appropriate communication for engaging with different communities about HCA research; and more regular and open conversations within families and communities around tissue donation for research.
- The successful implementation and positive outcomes achieved by One Cell At A Time have provided a model for on-going public engagement within the UK HCA and potentially across the wider Human Cell Atlas consortium. Time is now of the essence in order to build on these initial foundations and maintain the momentum for sustaining and embedding an effective art/science approach to engagement with the HCA across research and public communities.

⁸ Public participants: diverse and specific public groups/communities, children, young people, and teachers.

⁹ HCA members took part in the programme as participants, co-facilitators, and presenters.

Summary report

1. One Cell At A Time – public engagement with the Human Cell Atlas

The One Cell At A Time (OCAAT) project involved an ambitious and multi-faceted programme of public engagement with the Human Cell Atlas (HCA). The aim was to bring about a cultural shift towards enhanced and sustained engagement with the HCA across research and public communities. The project hoped to achieve this through working towards the following longer-term objectives, which were anticipated beyond the lifetime of the programme:

- Generate dialogue and transparency between HCA UK members and communities, that addresses questions and concerns around research and tissue donation, including use of language, GDPR and consent
- Build a culture within the HCA where UK members seek out and value the opinions and experiences of patients and communities who donate to research studies
- Co-develop a common language that enables HCA UK members to effectively communicate their work to different communities
- Normalise conversations within families and communities around tissue donation for research
- Create a foundation from which future public engagement activities across the whole HCA consortium can be built.

Funded by a research enrichment¹⁰ grant from Wellcome, the project was operational across four regions of England, nationally and online, from July 2020 to December 2021 and was co-located across six host institutions: Wellcome Sanger Institute (WSI), European Molecular Biology Institute-European Bioinformatics institute (EMBL-EBI); Kings College University of London (KCL); University of Newcastle; University of Cambridge; and University of Oxford.

Managed by a central project team¹¹, with scientific leadership from the PI¹² and three senior HCA members in their roles as work package leads¹³, One Cell At A Time developed, co-created and delivered a programme of art/science activities, events and resources in collaboration with a range of national partners, and four city-based teams of artists and producers/community engagement facilitators.

¹⁰ <https://wellcome.org/grant-funding/schemes/research-enrichment-public-engagement>

¹¹ Paul Gibson, project manager (Wellcome Sanger Institute - WSI); Suzy O'Hara, curator (freelance); Laura Rothwell, PR and marketing (Crystallised); Samantha Wynne, HCA scientific communications manager (WSI); Luke Portess, webpage and registry administrator (WSI); Tracey Andrew, executive administrator (WSI); Louise Walker (Wellcome Genome Campus Public Engagement team); Paul Bevan, Mark Wilson, Matthew Waller, Stephen Robinson, Web, Core Bioinformatics and Software Action team (WSI).

¹² PI: Sarah Teichmann, Wellcome Sanger Institute (Co-Chair of the HCA).

¹³ Work Package Leads: Muzlifah Haniffa, University of Newcastle; Krishnaa Mahbubani, Cambridge Biorepository for Translational Medicine; Anna Wilbrey-Clark, Wellcome Sanger Institute.

2. Evaluating One Cell At A Time

Helix Research and Evaluation was commissioned to undertake a programme-wide evaluation, the aim of which was to document and assess the progress of One Cell At A Time towards achieving its overall purpose, longer-term objectives and short-term outcomes. An overarching outcomes framework with collective evaluation questions and indicators was co-developed and co-delivered in partnership with the OCAAT team members.

Delivery teams were supported to collect both quantitative and qualitative data from participants (publics and HCA members), through pre- and post-event online surveys linked to the delivery of their engagement activities. Helix also undertook post-event interviews with a sample of participants and end-of-programme interviews with all OCAAT team members.

3. Outputs and reach

Evaluation data showed that over the lifetime of the project:

- 41 different events and activities (including multiple workshops, talks, discussions, sharing events, lab events, films, publications, online challenges, an online exhibition¹⁴ and the OCAAT website¹⁵) were delivered across 110 sessions¹⁶, leading to:
 - 1,067+ instances of engagement with public participants
 - 128+ instances of engagement with HCA members.
- The total reach (from July 2020 to end of December 2021) was at least 7,047 in person and online engagements with public participants and HCA members. This includes post-event and legacy engagement via recordings on the HCA YouTube channel and via the OCAAT website and online exhibition.

4. Short-term outcomes for public participants and HCA members

There were significant short-term outcomes for the public participants and HCA members who engaged with OCAAT activities. Public participants included diverse and specific public groups and communities, children and young people, and teachers. HCA members took part in the programme as participants, co-facilitators, and presenters. The evaluation found robust evidence of multiple positive changes to people's attitudes, skills, knowledge, behaviour, connections and emotional responses in relation to the following core outcome areas: HCA research, tissue and organ donation for research; scientific (STEM) and medicine career pathways and opportunities; art/science public engagement. These are summarised in Tables A and B below and discussed further in Section 6 - Progress towards the longer-term objectives of One Cell At A Time.

¹⁴ <https://www.onecellatotime.org/exhibits/>

¹⁵ <https://www.onecellatotime.org/>

¹⁶ This included where one event or activity was delivered more than once

Table A: Summary of outcomes for public participants who engaged with One Cell At A Time

<p>Attitudinal outcomes</p> <ul style="list-style-type: none"> • Positive changes in attitudes (in terms of value and trust) towards scientific research, the Human Cell Atlas and science more generally • Positive change in attitudes and new perspectives in relation to organ and tissue donation and its use in HCA/biomedical research • Increased respect for the value of tissue donation for HCA/biomedical research • More willingness to discuss wishes around research and tissue donation with families and friends • Positive impact on attitudes towards art/science led approaches, methods and resources 	<p>Affective outcomes</p> <ul style="list-style-type: none"> • A sense of fun and enjoyment • Excited by the activity and the work of the Human Cell Atlas • Happy, positive, relaxed, calm, reassured • Interested and informed • Curious and a wish to discuss and explore further – inspired to be creative, whilst being challenged – development of new perspectives • Emotionally and intellectually moved and engaged • Connected, inclusive, listened to, valued – empowered by having a voice in a wider project • Proud, grateful, fulfilled – the feeling of achieving something
<p>Conceptual outcomes</p> <ul style="list-style-type: none"> • Increased knowledge about HCA research and how it is conducted • Increased understanding of how they can contribute to HCA research • Increased awareness of the value of their potential contributions to HCA research • Increased awareness and understanding of how HCA research affects them now and in the future • Increased understanding of human cells and how the body works • Greater awareness of the scale and global reach of HCA research • Increased knowledge of scientific terminology and broadened understanding of science more generally • Increased knowledge and understanding of tissue donation for research, particularly within the context of the Human Cell Atlas • Increased understanding around consent, data sharing and ethical issues in relation to tissue donation for HCA research • Increased awareness and understanding of the varied STEM and medicine career opportunities and pathways available • Understanding of the value of bringing art and science together to discuss complex issues • Increased understanding of how art and science intersect to explore new meanings, practices and patterns • Expanded understanding of the nature of different forms of art, dance and creativity • New ideas about sources of inspiration for creativity • Opportunities to be creative 	<p>Instrumental/behavioural outcomes</p> <ul style="list-style-type: none"> • Continued engagement with the project and/or similar activities in the future • New conversations with family members and peers about the impact and potential of research and the HCA project • Empowered to find out more about the HCA • Empowered to conduct their own research in areas of interest that HCA science had inspired • Empowered to explore more connections between art and HCA science • Inspired to find out more about human cells and biology • More conversations with friends and family around research and tissue/organ donation • Plans to clarify wishes relating to organ and tissue donation generally, and for research purposes and to do more fact-finding in this area to better inform decision-making • Greater interest in science and medicine subjects and career pathways; and in creative and artistic career pathways • Find out more about other artists and creatives working with the HCA and more widely • Find out more about art/science as an engagement approach • Continued creative and artistic work, including continuing work started during OCAAT activities and events in the following areas: poetry and creative writing; cells, patterns, movement and dance; game creation and use of data.
<p>Capacity-building outcomes</p> <ul style="list-style-type: none"> • New skills creating artistic forms, artefacts and practices in response to HCA research, including skills to present scientific ideas in a visual way, through creative writing or through use of poetry • New technical skills and practices in response to HCA research, including skills in how to design a card game • New personal development skills, including increased understanding of team roles • Development and delivery of new learning activities in response to HCA research 	<p>Connectivity outcomes</p> <ul style="list-style-type: none"> • New connections developed with a variety of colleagues across disciplines who are interested in creative collaboration • New forms of collective creativity developed • Connections developed between artists and scientists • Plans to stay in touch with some of other participants.

Table B: Summary of outcomes for HCA members who engaged with One Cell At A Time

<p>Attitudinal outcomes</p> <ul style="list-style-type: none"> • Increased willingness to view public engagement as a two-way opportunity for dialogue and to seek out multiple perspectives on HCA research • Increased willingness to consider using different methods for engaging communities and more confidence and motivation to do so • More willing and enthusiastic to engage and communicate with a range of different public groups and communities about HCA research • Increased respect for the value of organ and tissue donation for research • The use of more thoughtful and respectful language about donation • Increased willingness and motivation to get involved in co-creating art/science engagement activities. 	<p>Affective outcomes</p> <ul style="list-style-type: none"> • A sense of fun and enjoyment • Interested and reflective • Curious and inspired - a wish to discuss and explore further.
<p>Conceptual outcomes</p> <ul style="list-style-type: none"> • Broader recognition of the part all HCA members play to progress the work of the HCA • Greater understanding of the value of public contributions to HCA research and how engagement with communities can improve research quality • Increased understanding about the value of art/science led public engagement activities and how these can be successfully delivered to different public groups. 	<p>Instrumental/behavioural outcomes</p> <ul style="list-style-type: none"> • More discussions within the HCA community about doing more public engagement and formalising the role of public engagement as part of the HCA research going forwards • Increased consideration of public engagement in research planning and grant applications by HCA members • New public engagement activities developed by other research groups outside the HCA • Continued and increased engagement with the OCAAT programme • Changes to public engagement practice.
<p>Capacity-building outcomes</p> <ul style="list-style-type: none"> • Development of new communication skills in planning and delivering art/science led public engagement. 	<p>Connectivity outcomes</p> <ul style="list-style-type: none"> • New connections and relationships developed and maintained with external organisations, groups and communities, including artists, producers, public communities, teachers and school/college students • New collaborations and connections between HCA members and across research groups • New opportunities for internal networking to share ideas and learning, provide support for public engagement and to recognise and celebrate the work of the OCAAT programme as a whole.

5. Key learning from the implementation of One Cell At A Time

The evaluation highlighted some key determinants in the successful delivery of the OCAAT programme:

- Sustained strategic and financial commitment, including high level endorsement and advocacy, and investing in support for infrastructure as well as for programming activities
- Senior champions, demonstrating visible commitment to the public engagement initiative and encouraging engagement from researchers more widely

- Central coordination and curation, managing and providing direction for the programme of activities, and creating an environment in which relationships between researchers and publics can flourish
- Focus on depth of engagement, building relationships with public participants over time
- Use of an art/science approach to public engagement, providing new and diverse opportunities for engaging with science, and facilitating new entry points for publics who may not respond to traditional forms of science communication
- Partnerships with a range of external partners, extending the reach and depth of engagement with public participants
- Development of online resources, enabling significant additional online reach after activities and events have taken place, and creating ongoing opportunities for legacy engagement post-programme.

The evaluation also identified some challenges, mostly relating to the specific constraints of undertaking public engagement during a global pandemic, and the resulting move to online delivery. Whilst it is to be hoped that these constraints do not continue indefinitely, any future use of online delivery for public engagement will need to put in place strategies to address the identified barriers of this approach that include:

- Reduced reach in under-represented areas and groups due to limited internet and computer access, and lack of necessary support for virtual engagement
- Limited opportunities for participant recruitment in the absence of in-person approaches
- Limited communication between researchers, facilitators, and publics in the absence of face-to-face interactions.

Other challenges raised by evaluation participants related to the size and complexity of the project, and ways of working with the HCA. These point to the need for future public engagement initiatives to:

- Ensure that sufficient resources are available to match the scale and ambition of the project
- Extend timescales to allow relationships with publics and deeper engagement to develop
- Build in sufficient time for relevant sign-off processes from the start, so that engagement activity can proceed as planned
- Consider the merits of creating a social media presence for public engagement initiatives and develop policies and processes to provide a framework for such activity.

6. Progress towards the longer-term objectives of One Cell At A Time

Improved dialogue and transparency about HCA research

The sheer range and diversity of attitudinal and conceptual outcomes experienced by public participants provides strong evidence of improved dialogue and transparency about HCA research. Many people described newly acquired knowledge of the purpose, need, value and scale of the Human Cell Atlas and increased understanding of how HCA research might affect them now, and in the future. Participants expressed their increased knowledge of how HCA research is conducted and showed increased understanding of how they themselves may be able to contribute to the Human Cell Atlas.

Indeed, evaluation data provided evidence of positive changes in attitudes, increased knowledge and understanding and more respect towards organ and tissue donation and its use in biomedical research, particularly within the context of the Human Cell Atlas. Public participants' engagement with One Cell At A Time had also enabled them to share and explore their attitudes and understanding around some of the consent, data sharing and ethical issues involved in tissue and organ donation, in ways that they had not previously considered.

A culture within the HCA where UK members seek out and value the opinions and experiences of patients and communities who donate to research studies

Evaluation data from HCA members showed evidence of increased respect for the value of organ and tissue donation for research, which came about through open dialogue between HCA members and public communities. One OCAAT team member suggested that, significantly, the project had facilitated the use of more thoughtful and respectful language about donation by HCA scientists.

There was also increased willingness from HCA members to view public engagement as a two-way opportunity to seek multiple perspectives, and to have a dialogue with a range of public communities. The evaluation showed that HCA members were increasingly willing to consider using different methods for engaging communities and felt more confident and motivated to do so. There was also evidence from HCA members of greater understanding of the value of public contributions to HCA research and how engagement with communities can improve research quality. There was some initial evidence, in the short-term, that bringing together artistic and scientific perspectives had facilitated new, and creative, ways of conceptualising scientific questions and research ideas. It would be interesting to continue to map this outcome in the longer-term and to explore the on-going impact, if any, of art/science public engagement on the nature and content of HCA scientific inquiry.

More effective and appropriate communication for engaging with different communities about HCA research

A key objective of the OCAAT programme was to trial art/science-focussed approaches for engaging with different communities about HCA research. Evaluation responses indicated that these approaches had most definitely delivered effective and appropriate communication about the Human Cell Atlas enabling both publics and HCA members to recognise, explore and articulate the value of both scientific and artistic outputs and contributions.

Both public participants and HCA members described their engagement with OCAAT events as ‘fun’ and ‘creative’. They both talked about being ‘inspired’ and ‘interested’, and public participants said they felt ‘happy’, ‘involved’, ‘engaged’, ‘informed’, and ‘connected’. Evaluation responses from public participants suggested that 93% agreed that OCAAT activities had helped them to understand the value of bringing art and science together to discuss complex issues and had helped them to explore new meanings, practices and patterns. For public participants responding to the evaluation, 88% were inspired by OCAAT activities and events to reflect on new ideas; and 78% said that they learnt new skills to present scientific ideas in a visual way, or through creative writing and poetry.

In addition, evaluation evidence from HCA members indicated they had increased their understanding about the value of art/science led public engagement activities and how these can be successfully delivered to different public groups. Many HCA members described how they had developed new communication skills in planning and delivering art/science led public engagement and the inclusion of art and artists in the project was thought to have improved the communication of complex science and enhanced the development of accessible language and two-way conversations between scientists and publics

Evidence of more regular and open conversations within families and communities around tissue donation for research

Just under half (41%) of public participants responding to the evaluation said they were planning to have more conversations with friends and family around research and tissue/organ donation (19% had already done this irrespective of their involvement with the project). Responses suggested that sharing information about their wishes, and finding out about the wishes of others, were key areas for these conversations. People also talked about making plans to clarify wishes relating to organ and tissue donation generally and for research purposes; and plans to do more fact-finding in this area to better inform their decision-making. In addition, 58% of public respondents said they were definitely planning to start conversations with family members and peers about the impact of the event or activity they had attended and/or HCA research.

New foundations created for future public engagement across the whole HCA consortium

Instrumental outcomes for public participants members indicated a strong desire to ‘stay in touch’ with One Cell At A Time and the Human Cell Atlas more widely. People had made new connections and were keen to maintain these. Publics were inspired to continue and develop the artistic and creative work started during OCAAT activities and events and felt empowered to find out more about the HCA, human cells and biology. Many people talked about their intentions to conduct their own research in areas of interest that HCA science had inspired. Evaluation data from publics showed that 84% were interested in being involved in this sort of engagement activity again – clear evidence of a strong interest from a newly established network of potential participants for ongoing engagement with the HCA.

For HCA members, there was evidence of continued and increased engagement with the OCAAT programme over its lifetime and beyond, so creating a supportive ‘community of practice’ for art/science public engagement. HCA members described how they intended to stay in touch with the OCAAT team and artists; to be involved in other OCAAT events and activities; and had shared information with other colleagues leading to further increased

engagement with the programme. Being involved in OCAAT offered a ready-made platform for engagement and had inspired them to seek out new opportunities to engage with different communities. The programme had also provided opportunities for more formal recognition and reward of public engagement activities, particularly for early career researchers.

7. Concluding comments

The successful implementation and positive outcomes achieved by One Cell At A Time have provided a model for on-going public engagement within the UK HCA and potentially across the wider Human Cell Atlas consortium. Time is now of the essence in order to build on these initial foundations and maintain the momentum for sustaining and embedding an effective art/science approach to engagement with the HCA across research and public communities.

1. Context and background

1.1. One Cell At A Time – public engagement with the Human Cell Atlas

The One Cell At A Time (OCAAT) project involved an ambitious and multi-faceted programme of public engagement with the Human Cell Atlas (HCA). Funded by a research enrichment¹⁷ grant from Wellcome, the project was operational across four regions of England, nationally and online, from July 2020 to December 2021.

Managed by a central project team¹⁸, with scientific leadership from the PI¹⁹ and three senior HCA members in their roles as work package leads²⁰, One Cell At A Time delivered a programme of art/science activities, events and resources in collaboration with a range of national partners, and four city-based teams of artists and producers/community engagement facilitators²¹, including:

- 4 Art/Sci Salons - discussions between artists and scientists each focussed on a different HCA-related theme
- 6 Art/Sci Exchange meetings - events designed to share learning across the whole HCA and to foster new connections between OCAAT activity and HCA UK members
- ‘Mapping Covid-19’ – animated film for young people about how the HCA enhances our understanding of the virus
- ‘How to Build a Human’ card game challenge for schools – delivered in collaboration with Little Inventors and Heaves Design
- Poetry challenge for young people – in partnership with Newcastle Centre for Literary Arts (University Newcastle) and the Young Poets’ Network (Poetry Society)
- 28 public workshops - focussed around the themes of performing normality (‘Ways of Doing Things’, Cambridge), embodying normality (‘Donate Yourself’, Newcastle), sensing normality (‘Sensory Cellumonials’, London), and speculative normality (‘Call of the Silent Cell’, Oxford)

17 <https://wellcome.org/grant-funding/schemes/research-enrichment-public-engagement>

18 Paul Gibson, project manager (Wellcome Sanger Institute - WSI); Suzy O’Hara, curator (freelance); Laura Rothwell, PR and marketing (Crystallised); Samantha Wynne, HCA scientific communications manager (WSI); Luke Portess, webpage and registry administrator (WSI); Tracey Andrew, executive administrator (WSI); Louise Walker (Wellcome Genome Campus Public Engagement team); Paul Bevan, Mark Wilson, Matthew Waller, Stephen Robinson, Web, Core Bioinformatics and Software Action team (WSI).

19 PI: Sarah Teichmann, Wellcome Sanger Institute (Co-Chair of the HCA).

20 Work Package Leads: Muzlifah Haniffa, University of Newcastle; Krishnaa Mahbubani, Cambridge Biorepository for Translational Medicine; Anna Wilbrey-Clark, Wellcome Sanger Institute.

21 See Annex B for more details: Cambridge ‘Ways of Doing Things’: Anna MacDonald, Manchester Metropolitan University (artist) and Matt Burman & Hilary Cox Condron, Cambridge Junction (producers), Newcastle ‘Donate Yourself’: Stacey Pitsillides, University of Northumbria (artist) and Dominic Smith (producer); London ‘Sensory Cellumonials’: Amanda Baum & Rose Leahy, Baum Leahy (artists) and Justine Boussard (producer); Oxford ‘Call of the Silent Cell’: Vicky Isley & Paul Smith, Boredom Research (artists) and Kieran Cox, Miranda Lawrence and Cathrin Poppensieker, Fusion Arts (producers).

- ‘Constellations’ – workshops, experimental film and online publication
- 4 project Zines – a visual record of the public workshops
- 2 Lab events - to introduce the work of HCA scientists based at the Universities of Newcastle and Oxford
- ‘From Donor to Data’: One Cell At A Time Maker Jam– a week-long series of talks, workshops, collaboration and challenges, providing a space for digital artists, designers, makers and creative technologies to gather online to explore aspects of HCA science
- Online exhibition of artworks and 54 linked live events and performances, created and delivered by the four city-based teams of artists and producers
- One Cell At a Time website – including the online exhibition and other resources and artworks produced during the project.

One Cell At A Time was hosted by the Wellcome Sanger Institute (WSI), European Molecular Biology Institute-European Bioinformatics institute (EMBL-EBI), University of Newcastle, Kings College University of London (KCL), University of Cambridge and University of Oxford.

1.2. Purpose, longer-term objectives and intended short-term outcomes of One Cell At A Time

A theory of change was devised by the OCAAT project team, as part of their funding application to Wellcome. This describes the purpose, longer-term objectives (beyond the lifetime of the programme) and anticipated short-term outcomes (end of programme) that the project hoped to achieve. See Annex A for a copy of the full theory of change; key points are summarised below:

Purpose and longer-term objectives

The overall purpose of One Cell At A Time was:

- To bring about a cultural shift towards enhanced and sustained engagement with the Human Cell Atlas across research and public communities.

The OCAAT team hoped to achieve this aim through working towards the following longer-term objectives, which were anticipated beyond the lifetime of the public engagement programme:

- Generate dialogue and transparency between HCA UK members and communities, that addresses questions and concerns around research and tissue donation, including use of language, GDPR and consent
- Build a culture within the HCA where UK members seek out and value the opinions and experiences of patients and communities who donate to research studies
- Co-develop a common language that enables HCA UK members to effectively communicate their work to different communities

- Normalise conversations within families and communities around tissue donation for research
- Create a foundation from which future public engagement activities across the whole HCA consortium can be built.

Short-term outcomes

It was anticipated that the longer-term objectives would be achieved through evidence of short-term outcomes for public participants and HCA members who engaged with the project's multi-faceted programme of art/science activities. Thus, in the short term (post activity/end of project), the OCAAT project aimed to bring about changes in relation to the following core outcome areas:

- **HCA research** - communities that engage with the HCA are enabled to have a voice and to realise the value of their contributions to HCA research. HCA UK members have greater confidence to engage with the public and recognise the part they each play to progress the work of the HCA
- **Tissue and organ donation for research** (including around use of language, GDPR, consent and open access data) – people involved have more conversations with their friends and family around research and tissue donation
- **Scientific (STEM) and medicine career pathways and opportunities** – the young people and communities involved in the activities are more aware of the varied career opportunities and pathways provided through knowledge of STEM subjects and medicine.

During the set-up phase of the evaluation, we worked together with city-based teams and other project partners to ensure the pre-existing theory of change was relevant to their plans and needs. This included adding an additional short-term outcome to the theory of change follows.

- **Art/science led public engagement approaches, methods and resources** – art/science-focussed public engagement approaches, methods and resources are trialled which recognise, explore and articulate the value of both scientific and artistic outputs and contributions.

1.3. Evaluation aim and approach

Helix Research and Evaluation was commissioned to undertake a programme-wide evaluation, the aim of which was to document and assess the progress of One Cell At A Time towards achieving its overall purpose, longer-term objectives and short-term outcomes.

Overarching outcomes framework with collective evaluation questions and indicators

The evaluation's logic model (see Annex B) starts from the hypothesis that despite the differences in context and activity, there were likely to be some common short-term outcomes for public participants and HCA members engaged with the OCAAT project. The logic model

made explicit what we thought some of these outcomes would be whilst also being open to the inclusion of additional or unexpected outcomes.

We used the following conceptual map²² for understanding the nature of the likely changes for public participants and HCA members that might emerge in relation to the core outcome areas (HCA research, tissue and organ donation for research, scientific (STEM) and medicine career pathways and opportunities, art/science led public engagement approaches, methods and resources):

- Attitudinal outcomes – changes to attitudes and motivations
- Conceptual outcomes – contributions to understanding, knowledge, debates and directions in thinking
- Capacity-building outcomes – transfer of skills through technical, artistic and personal skills development
- Instrumental/behavioural outcomes – altering behaviour; influencing the development of policy, practice or service provision; shaping legislation
- Connectivity outcomes – establishing and maintaining relationships with people and communities
- Affective outcomes – sensory, emotional and experiential responses.

We expected these short-term outcomes to be reflected within the art/science public engagement activities that individuals engaged with, and to be apparent by the end of the OCAAT project as a whole. We also expected that these outcomes would help to show progress towards the desired cultural shift, reflected by the aim and longer-term objectives outlined earlier (and which were anticipated to be realised beyond the lifetime of the programme itself).

Our approach was therefore based on an overarching, collective, co-developed outcomes framework (see Annex D), and a set of customisable evaluation questions and indicators for use across the whole project.

Co-developed planning, delivery and shared learning

In collaboration with artists, producers, work package leads and the OCAAT project team, we agreed a co-developed project-level evaluation plan (see Annex C) which, as far as possible, met the needs and interests of all project partners and contributors. This included revisiting the theory of change and adding an additional short-term outcome area relating to art/science-led public engagement approaches, methods and resources – see 1.2 above.

²² These outcome categories draw on (a) the Arts Council Generic Learning Outcomes for individuals engaged with the arts and culture sector; and (b) a framework commissioned by the ESRC to understand the potential outcomes of social science research - <https://esrc.ukri.org/files/research/research-and-impact-evaluation/research-impact-on-practice/>

We worked closely with city-based teams and other project partners to gather a range of qualitative and quantitative data from multiple perspectives to address the aim of the evaluation. We supported them to collect both quantitative and qualitative data, through pre/post event evaluation activities linked to the delivery of their engagement activities.

The evaluation was both summative and formative: findings and learning from individual evaluation activities were fed back to delivery teams throughout the project, and to the project management team mid-programme.

1.4. Overview of evaluation methodology

The evaluation plan (see Annex C) outlines the collective outcomes measured, the data required and the methods for data collection. The overall methodology is summarised briefly as follows:

Pre- and post-event online survey for participants (Q1 and Q2)

Pre-event online questionnaires (Q1) were designed for 19 of the 26 OCAAT activities that Helix evaluated to gather baseline data in relation to core expected outcomes. These were delivered, via a web-link, by city-based teams and other project partners to HCA members and/or public participants before their engagement in OCAAT activities. By the end of the programme, 138 fully completed Q1s had been received.

Post-event online questionnaires (Q2) were designed for all 26 of the OCAAT activities evaluated by Helix, delivered to participants via a web-link as above. By the end of the programme, 334 fully completed Q2s had been received, providing post-activity data in relation to a range of key outcome areas.

The pre- and post-event questionnaires were designed to map changes in people's attitudes and knowledge/understanding in relation to the core outcome areas (HCA research, tissue and organ donation for research, scientific (STEM) and medicine career pathways and opportunities, art/science led public engagement approaches, methods and resources). In the post-event questionnaire (Q2), there were also structured and free-text questions to capture respondents' skills, perceptions, feelings and intended actions. At the end of the Q2 questionnaire, participants were invited to give consent for Helix to contact them about a short follow-up interview (Q3) to explore their experiences further.

Post-event interviews with participants (Q3)

Post-event individual interviews (Q3), to explore outcomes and responses to the events in more detail, were conducted by Zoom with participating HCA members (n=5) and public participants (n=15) opting in via a question during Q2. The interviews were audio-recorded and transcribed.

This dataset was supplemented with additional Q3 data (n=7) collected by project partners which included an interview with the three winners of the Schools Card Game Challenge, and questionnaires completed by the four winners of the Poetry Challenge.

Interviews and group discussions with the OCAAT project team, city-based teams and other project partners

End-of-programme group interviews were conducted with all seven activity teams plus the OCAAT project management team and two work package leads to explore reflections on the programme as a whole (n=12).

Data analysis

By the end of the project, a range of quantitative and qualitative data had been collected. Interview data were analysed thematically via Taguette (qualitative analysis software), and questionnaire data were downloaded to Excel for analysis of frequencies and descriptive statistics, and additional qualitative analysis as needed.

Reporting

As stated above, findings from evaluation of individual OCAAT project activities and events were fed back, as mini reports, to delivery teams throughout the project. In addition, two interim reports were produced for the OCAAT project team, distilling formative findings.

This final report presents an assessment of the implementation of the One Cell At A Time programme and the extent to which its stated aims and associated outcomes have been achieved. It also presents an analysis of successes, challenges and lessons learnt from delivering the programme, and draws out conclusions and recommendations to inform the development of future similar public engagement work.

Report findings are illustrated with direct quotations from evaluation participants. To preserve the anonymity of these sources, the quotes have been attributed to one of three main categories: 'OCAAT team member' (includes the OCAAT core team, work package leads, and city-based and other creative teams); 'HCA member' (includes HCA researchers participating in the OCAAT events and activities); or 'Public participant' (includes all adults, children and young people participating in OCAAT events and activities).

2. One Cell At A Time – inputs, activities, outputs and reach of the project

This chapter describes the key inputs, activities, and outputs of One Cell At A Time. For an overview and summary of these, please see Annex B.

2.1. Inputs

Funding and host institutions

The Wellcome Sanger Institute (WSI) was awarded a research enrichment²³ grant from Wellcome of £348,810 over 18 months (July 2020 to December 2021) to set up and implement public engagement with the Human Cell Atlas (HCA) through the One Cell At A Time (OCAAT) project. The grant was held by the Principal Investigator (PI) Sarah Teichmann, Head of Cellular Genetics at WSI and Co-Chair of the HCA.

The project was co-located across six host institutions: Wellcome Sanger Institute (WSI), European Molecular Biology Institute-European Bioinformatics institute (EMBL-EBI); Kings College University of London (KCL); University of Newcastle; University of Cambridge; and University of Oxford.

Core team: management, curation and scientific leadership

OCAAT was managed overall by Paul Gibson, Project Manager for Cell Atlasing projects at the Wellcome Sanger Institute, working in close collaboration with the project's curator, Suzy O'Hara (freelance/University of Sunderland), and with support and input from Louise Walker (Wellcome Genome Campus Public Engagement team). Together, Paul and Suzy led the project and were responsible for high/strategic-level coordination with the HCA Executive Office (UK), the PI and scientific leads.

As curator, Suzy was responsible for the day-to-day coordination of the project, including developing the programme of engagement activities and events, recruiting and managing a team of sub-contracted external partners (artists, producers, evaluators²⁴, PR and marketing consultant²⁵) and working in partnership with WSI and HCA staff involved in supporting the administration of the project.

Scientific leadership for the project was provided by the PI Sarah Teichmann, and three senior HCA members in their roles as work package leads: Muzlifah Haniffa (University of Newcastle), Krishnaa Mahbubani (Cambridge Biorepository for Translational Medicine) and Anna Wilbrey-Clark (WSI and EMBL-EBI).

²³ <https://wellcome.org/grant-funding/schemes/research-enrichment-public-engagement>

²⁴ Margaret Macadam and Ruth Townsley, Helix Research and Evaluation – www.helixresearch.co.uk

²⁵ Laura Rothwell, Crystallised - <https://crystallised.co.uk/>

City-based delivery teams and external partners

OCAAT activities and events were delivered by four city-based teams (of artists and producers/community engagement facilitators) and additional external partners as follows:

- Cambridge ‘Ways of Doing Things’: Anna MacDonald, Manchester Metropolitan University (artist); working with Matt Burman and Hilary Cox Condron, Cambridge Junction (producers)
- Newcastle ‘Donate Yourself’: Stacey Pitsillides, University of Northumbria (artist) working with Dominic Smith, freelance (producer)
- London ‘Sensory Cellumonials’: Amanda Baum and Rose Leahy, Baum Leahy (artists); working with Justine Bousard, freelance (producer)
- Oxford ‘Call of the Silent Cell’: Vicky Isley & Paul Smith, Boredom Research (artists); working with Kieran Cox, Miranda Lawrence and Cathrin Poppensieker, Fusion Arts (producers)
- ‘How to Build a Human’ card game challenge for schools: Dominic Wilcox, Ellie Birkhead, and Phoebe Martin, Little Inventors; Richard Heayes, Heayes Design Toy and Game consultancy; and Unity Schools Partnership
- Poetry challenge for young people: Helen Bowell, Poetry Society’s Young Poets’ Network working with Sinéad Morrissey and Theresa Munoz, University of Newcastle’s Centre for Literary Arts
- ‘Constellations’ workshops, experimental film and online publication: Esther Teichmann, RCA and Chris Stewart, University of the Arts (artists); working with Jenny Bangham, University of Cambridge (workshops facilitator/researcher), Boris Jardine (writer), Deirdre Gribben (composer) and Studio Hato (production)
- ‘Mapping Covid-19’ animated film for young people: Jana Eliasova, WSI (medical illustrator); Nick Lewis, University of Sunderland (animation and production)
- ‘From Donor to Data’: One Cell At A Time Maker Jam and project Zines: Dominic Smith, freelance (producer, photographer and designer)
- One Cell At a Time website and online exhibition: WSI ICT, Web, Core Bioinformatics and Software Action team.

2.2. Activities, outputs and reach

One Cell At A Time delivered an ambitious and multi-faceted programme of public engagement with the Human Cell Atlas, co-created by the core team, artists and HCA members, and led/curated by Suzy O’Hara. For more details of all activities and how they were developed and delivered please see the full project report: Wellcome Strategic Support: Science Award report

(WSSS Q2 2021²⁶). A summary of the key activities, outputs and reach is given in Table 1 below and shows that:

- 41 different activities were delivered over 110 sessions
- There were at least 1,067 instances of engagement with public participants
- There were at least 128 instances of engagement with HCA members
- The OCAAT programme of events and activities delivered at least 7,047 engagements with public participants and HCA members, in person and online up until the end of December 2021. This includes post-event and legacy engagement via recordings on the HCA YouTube channel and via the OCAAT website and online exhibition.

Table 1: Summary of OCAAT activities, outputs and reach

Audience focus	Type of activity	No of sessions or events	No of public engagements ²⁷	No of HCA member engagements ²⁸	Total reach (includes online engagement post-event as recorded by OCAAT team)
HCA members	Art/Sci Exchange 1 (Meet the artists project launch) - 25/11/20	1	-	11	22
	Art/Sci Exchange 2 (Schools Challenge: How to Build a Human lunchtime session) - 13/1/21	1	-	8	-
	Art/Sci Exchange 3 (NCL postal pack) - 9/2/21	1	-	7	-
	Art/Sci Exchange 4 (SC meet the HCA Q&A) – 25/2/21	1	10	6	-
	Art/Sci Exchange 5 (CAM patterns and matching) – 16/3/21	1	-	4	-
	Art/Sci Exchange 6 (LDN Cellular Biology: A lunchtime time travel with Baum and Leahy) 21/4/21	1	-	4	-
	Constellations workshop 2 (Writing our cells) – 28/4/21	1	-	7	10
	Constellations workshop 3 (Donation and loss) – 30/4/21	1	-	4	-
Publics	Mapping Covid-19 – animated film	-	-	-	2,282 views July 2020 – Dec 2021

²⁶ Please contact Paul Gibson (WSI) for more detail/information about the WSSS Q2 2021 report

²⁷ Figures taken from City Teams events data collection forms; if not available then from OCAAT tracking database. Figures here indicate participation in live events only and do not include numbers reached via online engagement post-event (e.g. YouTube views, etc). Numbers also indicate number of engagements, rather than number of individual people engaged, as individuals may have participated in more than one event.

²⁸ Numbers indicate number of engagements, rather than number of individual HCA members engaged, as individuals may have participated in more than one event or activity.

How to Build a Human card game challenge: Teacher CPD - 8/1/21	1	29	1	-
How to Build a Human card game challenge – open online from Jan to April 2021	-	111 entries	-	-
Poetry challenge – open online from Nov 2020 to Jan 2021	-	323 entrants	-	-
Oxford ‘Call of the Silent Cell’ workshops (2) – 1/2/21; 8/2/21; 22/2/21; 1/3/21; 24/3/21	5	31	3	17
London ‘Sensory Cellumonials’ advisory panel meetings - 15/1/21; 18/2/21; 3/6/21, and workshops (3) - 11/3/21; 13/5/21	5	36	6	38
Cambridge ‘Ways of Doing Things’ workshops (3) – 11/2/21 to 10/6/21 (donor recipients); 9/5/21 and 16/5/21 (publics; and 30/4/21 to 6/6/21 (young carers)	16	72	3	-
Newcastle ‘Donate Yourself’ workshop – 23/3/21	1	7	-	-
Constellations workshop 1 – 23/4/21	1	13	-	-
‘From Donor to Data’: Maker Jam events (5) - <i>Pre-event city-based ‘Datarama’ events to raise awareness</i> - <i>Launch night – 10/6/21</i> - <i>Lunchtime Lab session Haniffa Lab – 11/6/21</i> - <i>Lunchtime Lab sessions EMBL-EBI – 14/6/21</i> - <i>Talk: Exploring normality – 12/6/21</i>	12	85	13	420
One Cell At A Time website	-	-	-	2,658 visits: 27/10/21 - 28/11/21
One Cell At A Time online exhibition Launch – 28/10 (online)	1	85	16	111
London ‘Sensory Cellumonials’ Portal 1 TASTE opening event – 29/10 (in person)	1	45	1	55
London ‘Sensory Cellumonials’ Portal 5 VISION opening event – 2/11 (online)	1	9	1	25
Oxford ‘Call of the Silent Cell’ live screening and artist Q&A - 20/10 (in person)	1	17	1	-

	Newcastle 'Donate Yourself' AR posters and in-person artists tour – 31/10; 14/11; 21/11(online and in person)	3	21	1	1,025 public realm views across NCL, OX, CAM and LDN
	Cambridge 'Ways of Doing Things' one-to-one live performances - 30/10, 31/10, 2/11 and 3/11 (in person)	48	48	-	-
HCA members & publics	Art/Sci Salon 1: The New Normal - 30/7/20	1	35	5	126
	Art/Sci Salon 2: Technologies of Seeing - 2/12/20	1	58	11	122
	Art/Sci Salon 3: Donating our Cells, Our Selves - 9/6/21	1	4	2	77
	Art/Sci Salon 4 : From Donor to Open Data – 16/6/21	1	4	2	59
	Haniffa Lab event - 7/12/20	1	14	7	-
	Oxford Lab event – 5/2/21	1	10	4	-
Total	41 different activities over 110 sessions		1067+ public engagements	128+ HCA member engagements	7,047+ total in person and online reach

3. Outcomes for public participants

This chapter examines the way that public participants responded to One Cell At A Time engagement activities, and explores the questions:

- What have public participants (including diverse and specific publics, young people and teachers) gained as a result of their engagement?
- Is there any evidence of changes to their attitudes, skills, knowledge, behaviour, connections and emotional responses in response to?
 - Human Cell Atlas and scientific research
 - Tissue and organ donation for research
 - Scientific (STEM) and medicine career pathways and opportunities
 - Art, dance and creativity – particularly art/science led public engagement approaches, methods and resources.

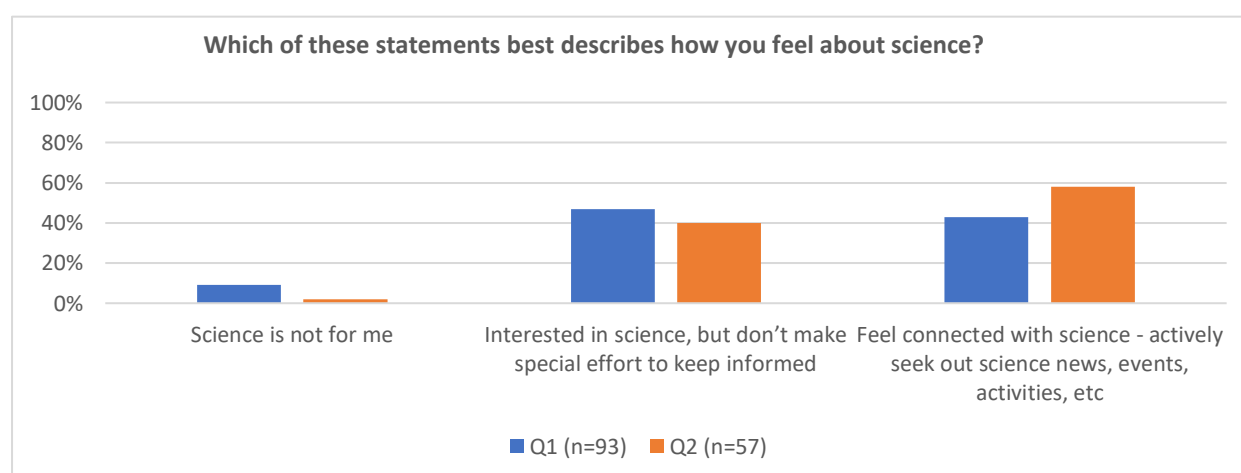
3.1. Attitudinal outcomes – changes to attitudes and motivations

Questions at Q1, Q2 and Q3 explored attitudinal outcomes for participants in relation to the Human Cell Atlas and scientific research; tissue and organ donation for research; and art, dance and creativity. Insufficient data were available on attitudinal outcomes relating to STEM and medicine career pathways to enable any meaningful findings to be drawn.

Attitudes towards science

Pre-event (Q1) and post-event (Q2) questionnaires asked participants to indicate which of three statements best described how they felt about science (see Figure 1). There was evidence of a small positive change post-activity (Q2), with a shift towards more people feeling connected with science, and actively planning to seek out science news and events (from 40% at Q1 to 58% at Q2); and slightly fewer people feeling that science was not for them (from 9% at Q1 to 2% at Q2).

Figure 1: Public participants' attitudes towards science



Attitudes towards scientific research

The word clouds²⁹ below present a summary of data in answer to the question: ‘what words come to mind when you think about scientific research?’, which was asked at Q1 and Q2. Free text answers show post-activity, people still perceived scientific research as ‘exciting’, ‘interesting’, linked to data and discovery and very much a ‘lab-based’ activity, but with much more emphasis on scientific research as ‘creative’, ‘ethical’, ‘human’ and about ‘understanding’.

Figure 2: Public participants’ pre-event perceptions of scientific research (Q1 n=92)



Figure 3: Public participants’ post-event perceptions of scientific research (Q2 n=47)



²⁹ We used TagCrowd to create word clouds, setting the maximum number of most frequently cited words to display as 30, and the minimum frequency of words as 2.

The following responses from Q2 and Q3 respondents explain these themes in more detail and show evidence of the positive impact that the OCAAT events had on people’s attitudes (in terms of value and trust) towards science and scientific research.

“Participating in this competition made feel that science is really an important thing and we need to appreciate scientists and their work.” (Q2 public participant)

“The challenge made science feel more approachable for me. It made me see that science is not just a binary discipline but that there are grey areas and plenty of room for creativity.” (Q2 public participant)

“It made me feel as though science isn’t all about flicking through a wordy textbook, and that it can also be about creativity and discovery. I have learnt about all the amazing things that make up the human body, and how important they ALL are. From now on, I will respect the human body more.” (Q2 public participant)

“I think, perhaps those personal testimonies, they make you feel more connected to the science and the medicine that makes those things possible. In it, you get a sense of how ... it’s not just something that happens in a lab. Its effects happen to real people, individuals and their families.” (Q3 public participant)

“I just think that obviously the more research is supported ... the better it is for all of us. Same thing - the more science and research that takes place, the more help there is for people on an individual, a group or a global kind of worth.” (Q3 public participant)

Attitudes towards the Human Cell Atlas

With regards to their attitudes towards the Human Cell Atlas, 70% of Q2 respondents agreed with the statement ‘the research that HCA scientists do looks interesting’. In addition, at both Q1 and Q2, respondents were asked: ‘what words come to mind when you think about the Human Cell Atlas’. As Figures 4 and 5 show, pre-engagement, people’s views of the HCA were firmly focussed on its purpose and role in ‘mapping’ the human cells of the body, whereas post-activity, key words were more focussed on the potential of the HCA for ‘collaboration’, to be ‘creative’, and as an ‘important’, ‘innovative’ and ‘interesting’ scientific endeavour.

Figure 4: Public participants’ pre-event perceptions of the Human Cell Atlas (Q1 n=100)



Figure 5: Public participants' post-event perceptions of the Human Cell Atlas (Q2 n=117)



The positive change in attitudes towards scientific research and the Human Cell Atlas was emphasised by some of the public participants who took part in Q3 interviews. The quotations below demonstrate the impact of One Cell At A Time on people's attitudes towards the HCA, where post-event perceptions were centred around the ambitious and collaborative nature of the science being undertaken:

"Yeah, because I think all of those things, you know, open data, sharing information, or as a human being able to say, well, when I'm when I'm gone, you can use what information you can gather from my body, to help other people is very, like a collaborative thing." (Q3 public participant)

"Yeah, so I think I stuck with ambitious, and that's probably a word I'd picked up from what I'd read about the Human Cell Atlas already. So I guess that just came out of being informed about their research. And I guess I drew parallels to the Human Genome Project, which was something that was gaining pace when I was a student in school, studying biology. So I guess the prospect of introducing my students to the equivalent, to a project that might have similar weight and influence, I thought was very important." (Q3 public participant)

During some of the Q3 interviews, public participants also highlighted the creativity and innovation inherent in HCA science, as well as its potential for improving understanding of human biology. People talked eloquently about the vast scale of the endeavour and noted their appreciation of how HCA science was helping to illuminate areas of knowledge that had never before been visualised:

"Maybe it gave me more a feeling about the creativity of it, as opposed to that sort of laboratory, rather dry impression. And I think maybe also some of the stuff that has come out around our knowledge of COVID and the vaccine has also shown a lot of the courage and the creativity that's involved. Not just the scientific knowledge." (Q3 public participant)

"I think the workshop kind of made me think about it a bit more. And actually ... made me appreciate ... biologists and kind of Cell Atlas stuff a bit more because, yeah, is some of the stuff about scale. So one of the things that I started thinking about a bit was, sea monsters, basically. So there are questions in all work about sort of, how do you visualise what you can't see? And how do you think about scale in relation to that?" (Q3 public participant)

"I think it's very similar to what I was thinking about research before. And to think about it in the abstract, as opposed to thinking about after having a conversation with an actual researcher and digging a little bit deeper into the purposes of this. You know, that and understanding the implications of it. Not that there's anything necessarily wrong with knowledge for its own sake. But I suppose by the second workshop, and definitely enough to fill in some of the colour in that picture as far as what was going on. And I really liked the fact that there wasn't necessarily an end point in it. But there was this understanding that by expanding this knowledge and building a clearer picture of what has gone on in the human body, then we don't really know what will come of that. But hopefully, there'll be some aspects of that that will be useful in various ways." (Q3 public participant)

Attitudes towards organ and tissue donation for research

Where relevant, we asked public participants at some OCAAT events about their attitudes to organ and tissue donation for research: 'what words come to mind when you think about organ and tissue donation for research?'. Findings from the Q1 and Q2 survey responses show that pre-activity (see Figure 6), people saw organ and tissue donation for research as something 'essential', 'important' and 'helpful', and linked to 'death'. But post-activity (see Figure 7), the key words used were 'necessary', 'important' and 'helpful', with less emphasis on the idea of 'death' – a very subtle, but positive change, maybe highlighting there is a need for donation for research purposes that perhaps people had not realised initially. The importance of paying attention to 'ethics' and following an ethical process for dealing with human remains was also noted by public participants, both pre- and post- activity.

Figure 6: Public participants' pre-event perceptions of organ and tissue donation for research (Q1 n=68)



Figure 7: Public participants' post-event perceptions of organ and tissue donation for research (Q2 n=49)



Where relevant, we also asked Q2 respondents to indicate the extent to which they agreed with a number of statements relating to organ and tissue donation (see Figure 10, page 33). In response to one of these, 91% of public respondents said, that as a result of taking part in OCAAT activities, they regarded organ and tissue donation for research as a ‘good thing to do’. The quotes below taken from Q3 interviews explain how for some people this positive change in attitude was a new perspective, whilst for others it was a perception that was reinforced through their involvement in One Cell At A Time activities.

“As far as organ tissue donation was concerned? Yeah. That has completely changed my perspective. But yeah. From whereas before, it was all about organ donation or tissue donation, to help another individual, it’s changed that perspective to being just a really generous thing that any of us can do to help the rest of humanity.” (Q3 public participant)

“That made me more positive about the donation. Um, I mean, I had been a donor before. But I just felt that it was a more of an obligation than something that I felt was a desire, if you know what I mean. And now it feels more like a the more desirable to donate than an obligation. Yeah. I think that’s a really positive thing to take away from that.” (Q3 public participant)

“But I think understanding, it reinforces what an important thing it is to do, to be prepared to say yes to organ donation, tissue donation, etc.” (Q3 public participant)

“I don’t think it changed. It emphasised the importance of it. I mean, I’ve always been very pro it happening, but I don’t think it I didn’t need to be convinced about it. I think when you hear from someone personally, you realise all the complexities and well you didn’t realise all of them. But just in the brief time they had to talk, you just get an insight into the hugeness of the subject really, and their experience.” (Q3 public participant)

Responses from Q3 interviews further emphasised this positive change in attitudes and increased respect towards organ/tissue donation and its use in biomedical research, as illustrated by some of the following quotations:

“So I think maybe again, just that mental prompt of not thinking about it in the general, but actually dealing with individuals who had had organ transplants or had donated organs, or who needed them, hearing them talking on screen, I guess, that we did shift my attitude a wee bit from the general way, which of course does involve death one way of the other, to just the worthwhile bit.” (Q3 public participant)

“I think it just reinforced the importance of it for me. Yeah. But obviously that night, I can't say it in detail in a scientific way that I've got, I understand it anymore. But I think it is that it embedded more a sense of: this is really important. And it is important to all of us as individuals, to families, to communities to nations.” (Q3 public participant)

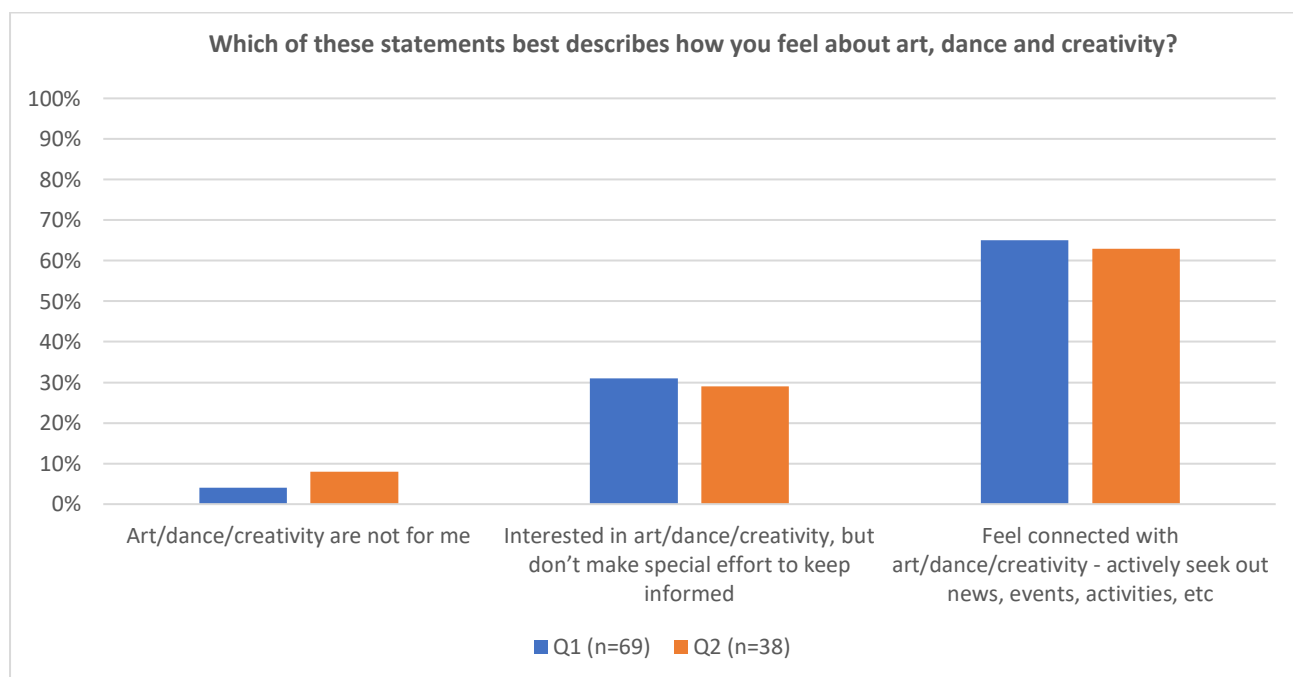
“I think maybe before this, maybe I would have made a more of an emotional thing kind of ‘they shouldn't be doing that with your body’. So it made me think a lot more intellectually. No, I just think it's really important that science is provided with the resources that it needs. And that is human tissue and, and human organs. And that's an important thing that we can all contribute to.” (Q3 public participant)

“I have a broad sense that yes, organ and tissue donation is really important ... But I guess there's a sort of suspicion and hate thing, right? The things that we know about medical institutions in the past and ethical decisions that have been made, and also the absence of ethical approaches ... And institutions that ask us to trust them can do really dreadful things with human remains ... And that doesn't mean that I don't think that organ to donation isn't important ... But I feel like if people are saying, “I don't trust institutions, because they've done these things in the past”, I also think that's valid.” (Q3 public participant)

Attitudes towards art, dance and creativity

We explored public participants’ attitudes to art, dance and creativity, by asking them to indicate which of 3 statements best described how they felt – see Figure 8 below.

Figure 8: Public participants’ attitudes towards art, dance and creativity



As Figure 8 shows, there was evidence of a tiny change post-activity, with a very small shift towards more people feeling that art, dance or creativity were not for them (from 4% at Q1 to 8% at Q2). This shift is so small and is further mitigated by the difference in overall response rate at Q1 (n=69) and Q2 (n=38), that it is more accurate to say there was no impact on attitudes in this area – perhaps because most people were already mostly interested or actively engaged. However, qualitative data from Q3 interviews and open-ended responses to Q2 questionnaires suggested that some of the OCAAT activities had indeed made a significant positive impact on people’s attitudes towards art/science led approaches, methods and resources in terms of:

- Broadened perceptions of a range of creative processes and how they can be used to make meaning and create artworks:

"I have to say before it happened, I couldn't sort of fathom what that would look like. But then the whole thing about hands and touch. Really, I thought, well, of course, touch is our first sense, and it's our last one to go. And our hands are such an important part of that." (Q3 public participant)

"It has broadened my notion of what poetry is and how it can be adopted in my artistic process." (Q2 public participant)

"I now view writing not just as a way to express a meaningful thought, but as a way to challenge the art of our phonetic bodies and the things that are lyrics by just their natural anatomy." (Q2 public participant)

"And also from an art point of view, I think they were probably quite inspired. Boredom Research use science as the basis. Their art is very unique, and it looks like a video game ... And I don't think a lot of our gaming students think that work can be considered 'art' ... Whereas our art students are, "we want our stuff in the gallery. We're making a political message". [And] our media students want their stuff in a film, so we go hire a person for the day and we put their films on. Whereas gaming students, it goes into a game, but I don't know if they've ever thought ... it could be in an art gallery. And that's - yeah, I thought the Boredom Research stuff was stunning." (Q3 public participant)

- Increased positivity towards the notion of creativity and its potential for exploring things in new and different ways:

"By entering the Human Cell Atlas Challenge, I had the opportunity to be creative. It helped me see things in a different and unique way, something I wouldn't usually expect." (Q2 public participant)

"The best thing about this challenge was getting to read something that might not be inherently poetic to begin with and yet having the freedom to include it in a poem." (Q2 public participant)

"It showed that poetry does not need to rhyme or make sense, as long as it contains imagination it is poetry." (Q2 public participant)

"I was a little sceptical about it being dance as the art form. And yes, that's just one of the most alien art forms to me. But also, I thought that might not be a very rich source of information or communication. But I was absolutely wrong! ... Because including things like more repetition and pattern and finding things that are similar and definitely following them through dance is absolutely much richer than I was expecting." (Q3 public participant)

"I was also kind of impressed by the way that the project has touched upon ritual and belief systems and the ways in which our bodies or our people are remembered and after death so that was that was something that, you know, I'm just getting to the age now where people of my age are sadly passing away and getting older and death is becoming a more frequent personal common experience. And I liked how that the project touched on, especially sort of embracing, you know, multiculturalism in many belief systems. So it felt quite warm in a way. And it certainly made me feel more engaged with it and it felt more appropriate for me to be involved because, you know, I was slightly reticent about joining in because I didn't feel I knew enough about it. And I don't think you necessarily need to have the sort of scientific interest or background in the project to be involved because it is so broad and so inclusive." (Q3 public participant)

- Changes to feelings of confidence, inspiration and enjoyment through engaging with the creative processes and OCAAT events and activities.

"While I believe that every poem we write changes the way we process writing, sticking to cells and related terms in my head while writing for this challenge boosted my confidence regarding including science in poetry more explicitly." (Q2 public participant)

"I am interested a lot of art forms ... But dance is not really one of my things to do. I enjoy going to dance events and watching them but so that and that particular sort of dance thing that we were doing was a little uncomfortable at first. Slightly awkward for me, to be involved. I did think it was great. And I think as it went on, and the awkwardness lessened, and you could see beyond that, then you could start to pick up patterns and feel connected with other things that were going on. So it was really powerful." (Q3 public participant)

“The use of the packet that was sent out I thought that was really interesting and the part that I wanted to get involved really, I study a design subject at the moment. And we’ve found that you know, being online on zoom all days very samey, and a bit difficult to engage with people and sometimes it’s hard to trigger ideas and inspiration. And so having that pack, and it was so beautifully created and put together and so well explained. And it really helped that I had to actually pick up a pen and write and draw on these little shapes and answer the specific prompts. And I really enjoyed that. And I found that really useful. And in fact, I’ve used it in, in my own sort of practice, at university, really different, obviously, different format, but you know, sending things out and, and having that transaction, I thought that was really nice.” (Q3 public participant)

“I mean, it was nice to do the writing. I mean, I’m doing quite a lot of writing at the moment. So it was, it was nice to do that kind of, you know, being given a prompt and sort of, you know, a time and being kind of directed to do that writing. So I found that a useful and interesting exercise.” (Q3 public participant)

3.2. Conceptual outcomes – increased knowledge and understanding

We were interested in any changes to people’s knowledge and understanding in relation to:

- Human Cell Atlas and scientific research
- Organ and tissue donation for research
- STEM and medicine subjects and career pathways and opportunities
- Art, dance and creativity.

Human Cell Atlas and scientific research

The Q2 questionnaires asked people to indicate the extent to which they agreed with a number of statements relating to conceptual outcomes. As Figure 9 shows, there was evidence that the OCAAT events and activities helped around two-thirds of public participants to understand the purpose of the Human Cell Atlas (67%).

Qualitative responses at Q2 and Q3 provided further evidence of participants’ increased knowledge about HCA research and how it is conducted. The quotes below highlight that HCA science was new to many people and that they had found ways to explain their increased understanding in their own words, with reference to contexts that were familiar to them:

“I learnt about what the Human Cell Atlas really is and I got to appreciate all the work which goes into finding about our bodies.” (Q2 public participant)

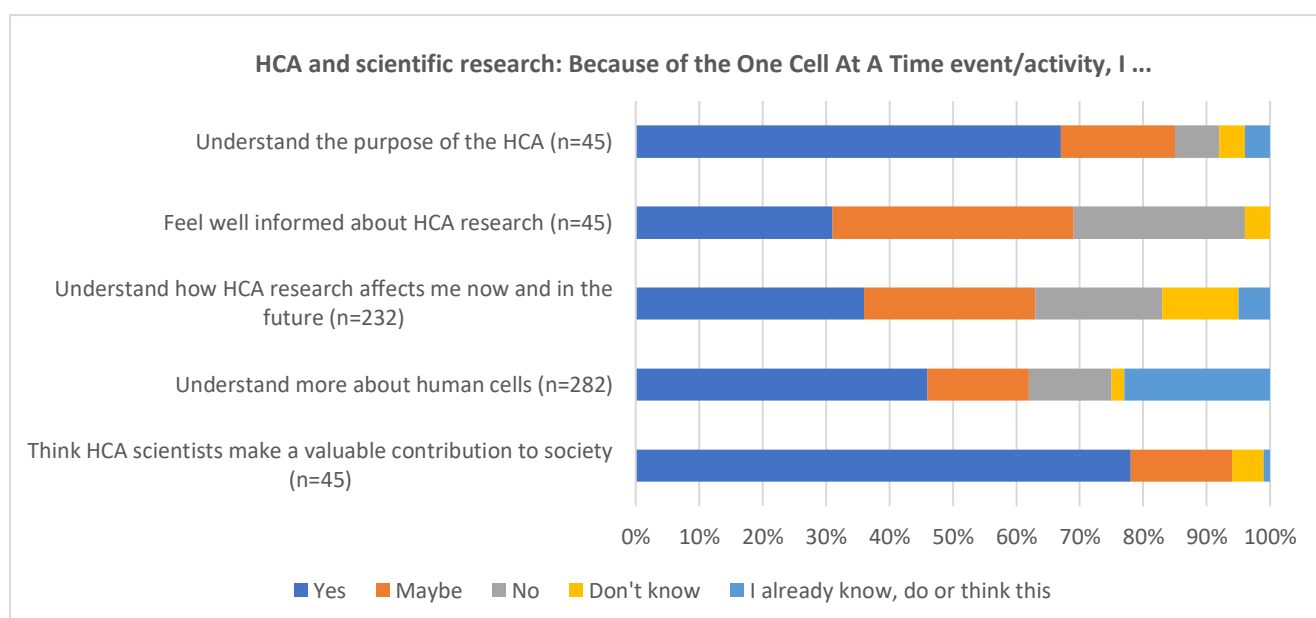
“I had no idea the Human Cell Atlas existed. The idea is interesting to me as someone who has always been interested in science, and especially biology.” (Q2 public participant)

“So I think maybe my understanding of it had changed. And I’m still not sure that I really grasp or that I would be able to explain to somebody properly. But literally just reading the words, Human Cell Atlas, I could only know of it what those words would tell me. So I imagined it was like a, I think of an atlas as a way of exploring a geography almost. And it sounded like a much more interactive sort of initiative whereby data and information would be shared between individuals and scientists and organisations and the public, it sort of feels more or less like a thing and almost like an organisation or system.” (Q3 public participant)

“I think after the workshop, I definitely gained more insight into the breadth and ambition of the project. And its sociological kind of importance.” (Q3 public participant)

“Well, the thing only in that sense is that it’s obviously going to inform medical science more and human science more, that is in it, in a way, to be helpful in terms of illness, disease, mortality, etc. So I don’t think my understanding is probably any broader than that.” (Q3 public participant)

Figure 9: HCA and scientific research – conceptual outcomes for public participants



In fact several people commented specifically on the fact that they had never considered the concept or need for mapping the cells of the human body, and that understanding the purpose of the HCA in this way was, in itself, was a significant outcome for them:

“It certainly brought me to the project, which is really interesting. And I wasn't aware of the project. And I suppose the other association I would have is the sort of mapping of the genome and, you know, this is another type of cellular mapping, which is really interesting to consider. So I was certainly interested to know about the project.” (Q3 public participant)

“I knew nothing about the Human Cell Atlas. I didn't know that there was any work going on this mapping process. In fact, I had no awareness that there was any need for the mapping process, I would probably have assumed that we knew about the cells were in the body, and without a biology background at all, but I would have made that assumption that we would know all that stuff already. So it was a bit of a surprise to me that it was this mapping process going on? And scratching the surface of it, you know, at the moment, but just the idea that it's not a process that is targeted towards, like treating cancer or something like that. It's much more foundational, which is why I use that word before that. And what is this level of knowledge of what's going on in the human body that is essential to know? What's the positive steps about health as well as the negative effects?” (Q3 public participant)

“I think I hadn't really appreciated, like, what cell mapping is? I hadn't really thought about what that was. And so yeah, I think that definitely increased my sort of appreciation of that work. And the ways in which it's creative, right. So I think, kind of, I suppose a starting assumption for me about any sort of mapping would always be that it's, it's creative. In terms of like, you know, it's not just drawing, I think what you see. But I hadn't really thought about the kind of how of that. And so that was quite exciting.” (Q3 public participant)

A few people at Q3 explained that they were still unclear about the purpose or aims of the Human Cell Atlas, despite having participated in one or more OCAAT events. This is reflective of the Q2 quantitative findings, where 7% said they had not understood and 18% said they maybe understood the purpose of the HCA:

“Somebody explained a bit about what the Human Cell Atlas is and what it does, but I didn't feel like it was enough to increase my understanding of it, you know, it would definitely make me if I came across it again, or if I knew that something was happening, it made me more interested in looking into that, or if I knew that there was an exhibition or a talk somewhere, then I probably would be interested and open to going.” (Q3 public participant)

"I feel like I don't know a lot about it still, you know, like a little bit was discussed at the workshop. But I don't feel like I could confidently talk to somebody else about it. So I know that I don't understand it enough and what its aims are." (Q3 public participant)

"But it's around collecting data from humans who've donated their cells and sharing that data amongst the scientific community for the purposes of research. But I'm not 100% convinced that that's correct." (Q3 public participant)

"I think it's unclear. It's unclear to me how developed it is, whether it's something that's happening, is being talked about is being developed or has been. And I would be unclear on how I would volunteer to get involved. I'm unclear, still." (Q3 public participant)

"I think I'm not still not 100% clear, I wouldn't be able to explain it to someone else. And I think my understanding of where it felt very artistic, as well as very scientific, and I'm not really clear where what the balance is there, whether it's whether this workshop was around the artist side and exploring these boundaries with people and exploring the understanding of the body and what body means to people, or whether it was to do with introducing people to the idea of the Human Cell Atlas, whether that's happening anyway, in science, and this is just an art bit tacked on to the outside. That was all a little bit unclear to me. Okay, is still." (Q3 public participant)

A second conceptual outcome from data collected at Q2 was that 78% of respondents who had participated in an OCAAT event now thought that HCA scientists are making a valuable contribution to society (16% said 'maybe', 5% said 'don't know' and 1% 'already knew this'). There were very few direct references to this outcome in qualitative data collected at Q2 and Q3, but some examples are given below:

"How HCA work with scientists from around the world is looking at revolutionising future understanding of how different parts of the human body work and renew itself." (Q2 public participant)

"And organisations and academics and companies and people, the public all working together and sharing information. And it feels futuristic, really, in the current era, where, you know, everyone has their own little bits of organisational knowledge, and they don't want to share because we're all competing with each other. This sounded and felt a bit like a step towards a much more supportive knowledge exchange and people trying to improve humankind through, you know, sharing medical and body data." (Q3 public participant)

"So I learnt about it more and found out that it was, in fact, very important, in a way that I wouldn't have been able to think about prior to the workshop." (Q3 public participant)

A third conceptual outcome for public participants was evidenced through nearly half (46%) of Q2 respondents saying that they now understood more about different cells in the human body (23% 'already knew this', 16% said 'maybe', 13% said 'no' and 2% said 'don't know'). The quotes below illustrate this outcome further and demonstrate increased understanding not only of human cells but also in relation to how the human body works:

"I think they [students] appreciated the complexity of an organ a lot more, but also grew in terms of confidence when discussing organs. So I think they've come away thinking, Yes, I know that there are lots of cells in the - I don't know - eye or skin, and I can name some of them. And they're probably quite aware of the fact their peers can't. So I think it's given them a lot of confidence." (Q3 public participant)

"I learnt more roles of the human cells and gained more knowledge in a fun way. I earned new facts related to the human body from your website. In addition, it was a great experience and really good fun. (Q2 public participant)

"Now we are doing cells in science at school and the teacher said that I knew things she taught A level students." (Q2 public participant)

"I also, for whatever reason, hadn't learned cilium existed in biology, so I did learn a bit about them as well." (Q2 public participant)

"It roused my interest on the many different cells in the human body. (Q2 public participant)

"The children have enjoyed watching videos on you tube about stem cells and their importance. They are interested in the future technology involved in understanding cells and stem cell technology." (Q2 public participant)

"From this experience I found out a lot about the human body and everything inside of it." (Q2 public participant)

"This challenge was inspirational and made me more interested to know the functions of cells." (Q2 public participant)

"This is where I guess a lot of it is about, you know, having some sort of baseline and knowing how cells work normally, or how they mature normally. So it's easier to find out when, you know, they're going into you know, disease states like cancers. I guess, a lot of it's really down to working out when a cell decides to become cancerous. Yeah, they this whole thing about that I read the other day. So, you know, this is a suggestion that every child born will have their whole genome sequenced at birth. Or the bit that's sort of easy to read. And that will point to a lot of the 600 most common problems. You know, they only know about these problems, because, they've studied cells and what happens when, you know, this bit of protein folds this way instead of this way." (Q3 public participant)

"I definitely learned more about how cells are and can be used, and the different ways that you know, bodies can inform science." (Q3 public participant)

There was also evidence that around one-third of respondents to Q2 had experienced conceptual outcomes in terms of understanding how HCA research might affect them now, and in the future (36%); and in terms of feeling well-informed about HCA research overall (31%). Several people commented on their greater awareness of the scale and global reach of HCA research.

"[I got] A better understanding of the importance of the research Human Cell Atlas are conducting." (Q2 public participant)

"I think the Human Cell Atlas is the main thing I didn't know about the project. It's an astonishing global effort, which is hugely impressive and I can see how very useful it would be to the human race in the future. And I didn't know anything about it prior to this." (Q3 public participant)

"This challenge allowed me to find out more about the Human Cell Atlas Research project and I think that the vast scale of the project is inspiring." (Q2 public participant)

"It was interesting and gave me a good understanding of the Human Cell Atlas." (Q2 public participant)

"The Atlas project is very interesting and will make big changes." (Q2 public participant)

Indeed, qualitative comments at Q2 and Q3 relating to the real-world application of HCA science highlighted the significance of these conceptual outcomes and showed the extent to which many participants felt informed and engaged with HCA science as a result of their involvement in one or more OCAAT events. The quotes below provide evidence of people's increased understanding of how they can contribute to HCA research and increased awareness of the value of their potential contributions to HCA research.

"How important that humans as a whole learn to understand themselves individuals and collectively as an integral part of the physical world. This kind of workshop is part of what we need to explore ways of spreading this understanding. I see it as a very early step into doing this." (Q2 public participant)

"It's a great project. The mystery of the human body cannot be understood through science alone. The workshop offered a good balance of perspectives. But I have reservations about the Human Atlas motives." (Q2 public participant)

"It's not just about scientific knowledge, it's actually about making leaps of faith and, and being brave enough to do something different. But I think it's made me .. feel a bit more like this is something that impacts on all our lives, as well, and that, therefore, it's not something that's remote, it's something that we're very connected to." (Q3 public participant)

"I think, you know, it's, I guess, it's really exciting to think about what implications that might have, you know, pretty profound ones. I mean, I've recently had treatment for cancer, you know, a fairly crude surgical treatment, you know, and it's interesting, I'm aware of, sort of immunotherapy being used for some cancers, you know, and it's definitely really interesting to perhaps imagine that this type of project might lead into much more specific targeted, you know, less invasive types of treatment for things like cancer or other diseases." (Q3 public participant)

"I was really impressed to see the extent to which the research would be applied to very real, human issues. So, to treating disease and... so I think it was the skin cell researcher was looking at how that will eventually - it wasn't burns treatment, but it was the equivalent. And then I think there was a focus also on certain types of blood cancers. So I really tried to get across to my students, off the back of that webinar, that although at the early stages of the project, mapping the cells and putting them together - in the same way that Google Map is put together - the eventual goal is for it to have more impact than just a set of data online. It's going to eventually impact our lives in a really significant way. And that's where forward-thinking comes from, I think. That they're already planning the application, at the early stages of the research project." (Q3 public participant)

There were also some other scientific and research-related conceptual outcomes noted by the public participants who responded at Q2 and Q3, namely around increased knowledge of scientific terminology and broadened understanding of science more generally.

"I learned many more scientific terms that I could use in the future." (Q2 public participant)

"Broadened my understanding of digestion, this would probably help me ace my biology exam through the poetic analogy logged in my memory!" (Q2 public participant)

"It helped me gain knowledge of science and how it's applied." (Q2 public participant)

"I also learned a thing or two about science/biology, as well as linguistics, which is nice." (Q2 public participant)

"I was able to showcase my knowledge of cytoplasm and other scientific processes, something I haven't done in my poetry before." (Q2 public participant)

One of the teachers who took part alongside her students in the Schools Card Game Challenge explained how she had made efforts to read more about the HCA research to ensure she could adequately support her students to understand it. This same teacher also explained how her own knowledge and understanding of biology had been enriched through involvement in the OCAAT activity.

"I personally didn't have capacity to support every individual student, so I paired them up with a member of the lower sixth. (inaudible) lower sixth will be a 16, 17-year-old. I set them individual tasks that would help them help the little person they were working with, so the 11, 12, 13-year-old. And, again, I felt it was my responsibility to pivot the opportunity to make it equally beneficial for them. And it's for that reason I had to read a bit more about the Human Cell Atlas and the research that is going on, to make sure I could have interesting conversations with my lower sixth, while I was allowing the little ones to draw their card game design, or whatever they were doing." (Q3 public participant)

"I was a little bit shocked of my ignorance of the fact that I thought skin was just skin. It never occurred to me that it was a collection of specialised cells... And never would I address it as an organ that has several tissue layers, each tissue layer having specialised cells. So I think there's an opportunity to build on the fundamentals of cell biology in the context of homeostasis and thermoregulation. So I think it alerted me to more opportunities for making cell biology teaching less theoretical and more contextualised." (Q3 public participant)

Organ and tissue donation for research

Where relevant to the event they had attended, the Q2 questionnaires asked people to indicate the extent to which they agreed with a number of statements relating to organ and tissue donation for research, in order to capture any conceptual outcomes in this area (see Figure 10). We also examined people's free text responses to the questions 'what did you get

out of the event or activity?’ and ‘what might you tell friends or family about the workshop?’ to explore any comments relating to conceptual outcomes relating to donation for research.

With reference to Figure 10, nearly two-thirds of public participants responding to the relevant Q2 questionnaire agreed that, because of their engagement with One Cell At A Time, they understood how scientists could potentially use donated tissue (61%), and trusted scientists to look after donation organs and tissue (61%). In addition, 36% said that they definitely (rather than maybe 40%) felt well informed about organ and tissue donation for research overall.

Qualitative data from Q2 and Q3 responses emphasised the role that OCAAT events played in supporting people to increase their knowledge and understanding of tissue donation for research, particularly within the context of the Human Cell Atlas.

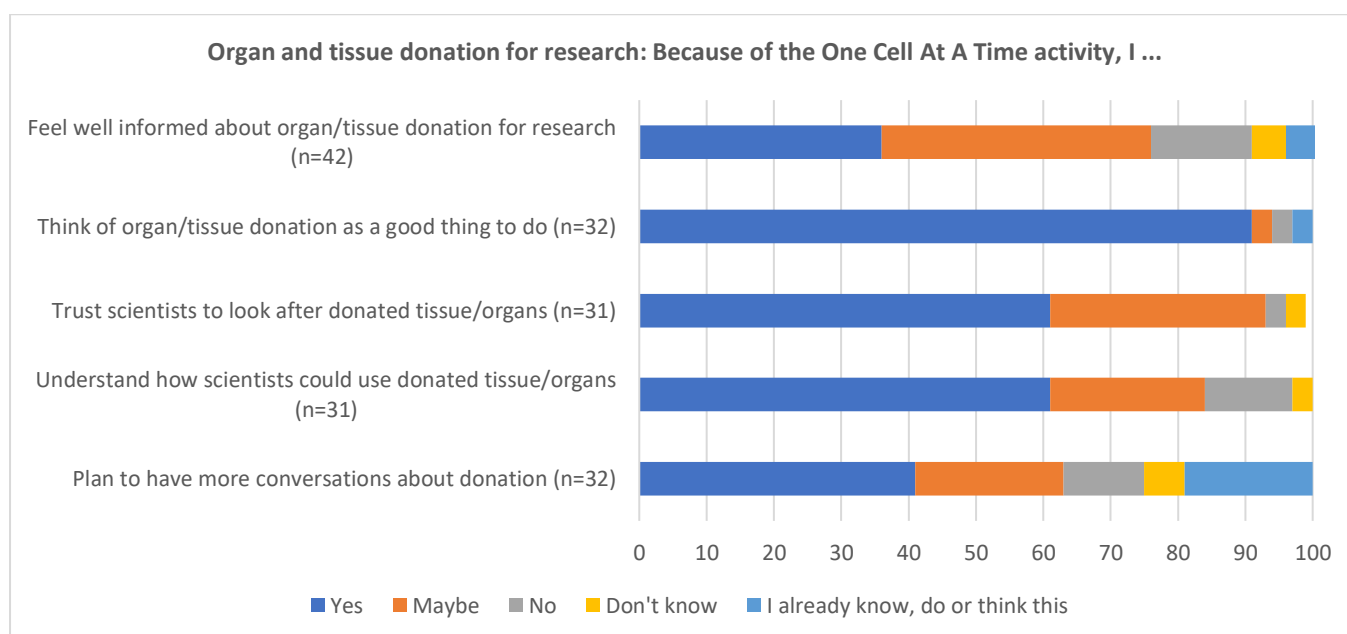
“It was interesting, I gained a new perspective on tissue donation for scientific research: where previously I realise I saw it as second best to donation for transplant, I'm now more aware of its contribution to humanity.” (Q2 public participant)

“I think I've got that from the discussion really, my thinking was only around organ donations, like living donations and organ donations after you died, and not I hadn't thought about things like people donating samples, and, you know, sick cells and tumours and things like that.” (Q3 public participant)

“And, you know, seeing you know, seeing the scientist present, you realise how, how far the technology has come in, like 20 or 30 years, you know? Now, from a single cell, they can get, you know, terabytes of information about what's happening. That technology wasn't there. 30 years ago, 20 years ago.” (Q3 public participant)

“[I now understand] That scientists need real tissue in order to make discoveries that could positively affect the whole of humanity.” (Q2 public participant)

Figure 10: Organ and tissue donation for research – conceptual outcomes for public participants



Q3 interviews shed further light on how participants had understood the notion of organ and tissue donation for research, and the extent to which OCAAT events had affected this understanding. Specifically, post-event, participants noted their expanded understanding and more positive attitudes towards the importance and value of donation for scientific research

(as opposed to donation for medical/transplant purposes) and highlighted the role that OCAAT activities had played in demystifying the ‘unknown’ in this regard.

“And I think I probably personally had always thought that a lot of tissue donation for medical science would be for like for training of medical practitioners floating around and pieces of bodies, which isn't necessarily the case. So I think that's one aspect of the unknown, as you know, what, what happens to it, whereas from the perspective that we had to it was about organ donation. It's easier to get a handle on whether as you know, if I donate a kidney, and it goes to someone I can, I think, yeah, okay, so the opening up, take out the open them up to the end of may not be how it all works, but I know that that's what's happening too. But just the general, sort of tissues for scientific researcher, that's a big, unknown.” (Q3 public participant)

“Because I really have a lack of knowledge in that area. But I hadn't really thought about it. I mean, I only really thought about bodies being used for research and for education purposes, for you know, students, student doctors, and I'd never really thought about any further than that about it. And the scientific communities who would use bodies for, for in depth research. And I just don't know, I didn't know an awful lot about it.” (Q3 public participant)

“Only when I thought about it, it made sense that that should occur, but I hadn't really considered it. And maybe that's just my lack of knowledge of the biological sciences? Because I really have a lack of knowledge in that area. But I hadn't really thought about it. I mean, I only really thought about bodies being used for research and for education purposes, for you know, students, student doctors, and I'd never really thought about any further than that about it. And the scientific communities who would use bodies for, for in depth research. And I just don't know, I didn't know an awful lot about it.” (Q3 public participant)

“I think that this project certainly has got a mainstream importance and I think could be a good resource for people to understand how organ donation can benefit. And because I think when people think of organ donation, they think of quite blunt use of organs, as in, you know, and your heart is a large portion of your body and is used for, is given to, to somebody who requires it. Whereas there's not very much information out there in mainstream about the depth of research that can be gained from tissue donation that can help with disease prevention, and things like that.” (Q3 public participant)

Interestingly, people also explained that participating in OCAAT events had also enabled them to explore attitudes and understanding around consent, data sharing and ethical issues involved in tissue and organ donation, in ways that they had not previously considered.

“I probably understood more about the difficulties of it afterwards, because of those challenges, of those assumptions, you know, my assumptions shifted a little bit. And, you know, if you'd asked me about organ donation, I would have probably just thought about prior to the workshop, just the standard thing that you can do through, you know, then the Blood Service and organ donation, whereas this workshop introduced me to the fact that actually, there's a whole other level of organ donation that you can take into account where you may be not donating your organs directly for use with somebody else, but you're donating them towards research. And whilst that's exciting, because it potentially opens up opportunities to donate your organs. It also becomes more challenging and ethically difficult to navigate when things like you know, the eggs thing. I thought that was the point that I thought gosh, yeah, you know, I'm happy to give my organs out when I've when I've got my cells to be used, but the idea of somebody harvesting eggs and making embryos, I'm not really comfortable with that. And that's something I've never even thought of.” (Q3 public participant)

“Organ or tissue donation that supports, you know, like, you know, you immediately support someone, like a heart. And then there's sort of, I guess, if, like, tissue donation that supports the further research? People are worried because, you know, one seems straightforward to them. And the other thing is a lot. For some reason, I don't know, it appears more scary to do more than donate your heart.” (Q3 public participant)

“I had skin cancer a couple of years ago and so I'm not allowed to donate blood anymore, and I think would not be allowed to donate organs either. And that's something that I've personally find really, really difficult because it was something I was very proud of, donating blood. And so I'm quite kind of upset and hurt by that. And the idea of potentially being able to use my body in other ways is like a solution to that aim.” (Q3 public participant)

STEM and medicine subjects and careers

For some of the OCAAT events and activities, we asked public participants to indicate the extent to which they agreed with the statement: ‘Because of the workshop, I know more about

different jobs in science'. Of those who responded to this question (n=239), 39% said that yes, through their engagement with the OCAAT project, they now knew more about different jobs in science, thus indicating increased awareness and understanding of the varied STEM and medicine career opportunities and pathways available. 16% thought that 'maybe' they knew more, whilst 25% said there was no impact on their knowledge. 8% didn't know, and 12% already had knowledge in this area.

Some of the free text Q2 responses from students (in answer to the question 'what did you get out of the event or activity?') explained these conceptual outcomes in terms of more understanding of the different and diverse roles that scientists can have, and recognition that (global) collaboration and teamwork is essential to these roles:

"[The workshop gave me] An insight into the different roles scientists can have." (Q2 public participant)

"Appreciating the diversity of people working on a single research project - today's Human Genome Project!" (Q2 public participant)

"I got to learn what the Human Cell Atlas is, which made me feel excited to know what scientists are working on and proud that they are coming together to work on a single global project." (Q2 public participant)

We conducted several Q3 interviews with teachers who had participated in OCAAT events and activities alongside their students. The teachers said they themselves had more insight into the breadth and range of roles that scientists can have, including those involved in the Human Cell Atlas, and that this, in turn, had an impact of the knowledge and understanding of their students.

"I think it's through that webinar that I thought, actually the breadth of specialisms contributing to this project is more than I had imagined it to be. And therefore I thought my first assumptions about the people involved with the project weren't as accurate as I thought they might have been... and I have a duty to showcase the variety of skill amongst the scientists that are working on this project to my students, to diversify their aspiration." (Q3 public participant)

"And she [a student] did talk a little bit about algorithms and maths. And I think that might have come across from me encouraging them to look at the diversity of scientists involved. So I think there are some concrete examples of use of technology in science and advanced biochemistry, which they've probably only addressed superficially, but I think the benefit is that they will have a familiarity with those ideas when they move further up the school." (Q3 public participant)

Art, dance and creativity

We explored conceptual outcomes relating to art, dance and creativity through a set of focussed statements asking participants to indicate some key things they had got out of the OCAAT event or activity, and via free text responses to the questions 'what did you get out of the event or activity?' and 'what might you tell friends or family about the workshop?'

As Figure 11 shows, almost all (93%) of the public participants responding to these statements agreed that the OCAAT activities they had taken part in had helped them to understand the value of bringing art and science together to discuss complex issues. The free text responses added detail to this finding, suggesting that participants gained increased understanding of how art and science intersect to explore new meanings, practices and patterns:

"It was a really interesting event mixing human biology and art and possibility / speculative practices." (Q2 public participant)

“That talking about the Cell Atlas can be creative, even entertaining and might work as a door opener for talking about donating.” (Q2 public participant)

“What I did (the rituals), about the different scenarios, the amazing way art and science can be combined, how inspired I was.” (Q2 public participant)

“About how interesting it was to combine the Arts with science in this way.” (Q2 public participant)

“How art and science can be used to think about things in different ways.” (Q2 public participant)

“How art is contributing towards science research.” (Q2 public participant)

“Getting a temporary creative writing outlet tailored to my interest in science was satisfying. The associative word poem was a new concept to me which gave clarity to the act of linking ideas & the direct relation to scientific language / a scientific project was refreshing, as opposed to generally incorporating themes and ideas.” (Q2 public participant)

“Seeing crossovers between sciences and humanities - it's something I would like to include in my poetry in the future.” (Q2 public participant)

That the sciences can intersect with the arts, I am currently doing a pharmacology degree at Dundee University and this cross over has piqued my interest in learning more, I have always been interested in both the arts and science.” (Q2 public participant)

“I got a new understanding of how science can be incorporated into poetry.” (Q2 public participant)

Figure 11: Art, dance and creativity – conceptual outcomes for public participants

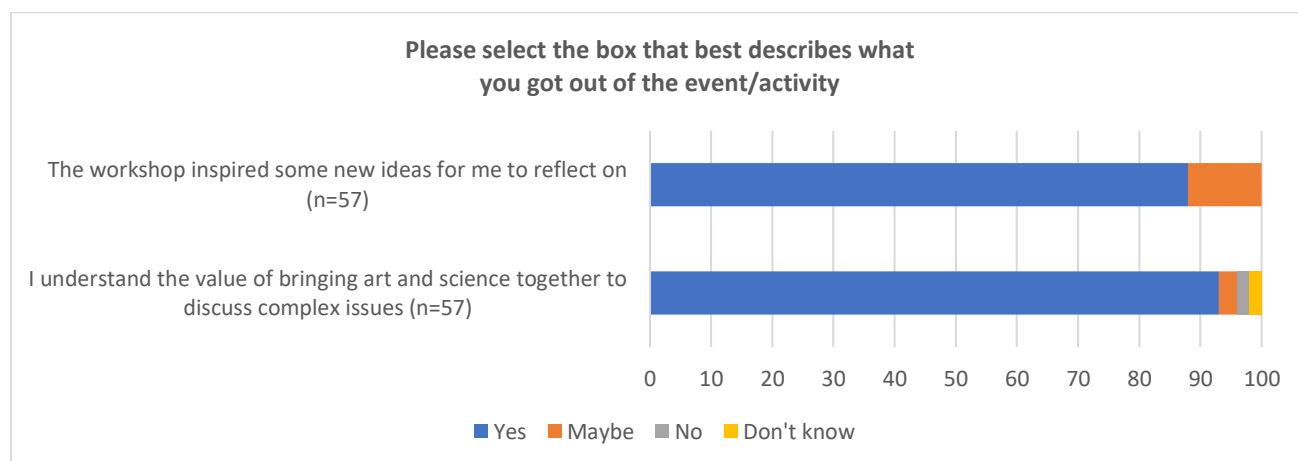


Figure 11 also shows that 88% of participants were inspired by the OCAAT activities and events to reflect on some new ideas. The free text responses articulate the sheer range and diversity of conceptual outcomes in this area:

- Expanded people’s understanding of the nature of different forms of art, dance and creativity:

“It expanded my idea of what poetry is!” (Q2 public participant)

“I have always been intrigued by the sounds and rhythm of poetry. To me sounds and rhythm are more important than words that seem to fundamentally make up poems. The challenge inspires me further to view sounds as the most important component of poetry. I think associating words echoes the idea of words being subject to readers' perspectives, and their 'meanings' can vary in every context.” (Q2 public participant)

"I've never thought of fully incorporating scientific terms into poems, usually they are not at the centre of the stage, but appear randomly to support the poem's theme. Your Poetry Challenge has provided me a new perspective." (Q2 public participant)

"It is ok to be guided by sounds rather than imagery and meaning, and meaning can often unintentionally emerge from the sounds." (Q2 public participant)

"It changed the way I looked at how poetry can be constructed." (Q2 public participant)

"How stimulating and creatively challenging it was. How world changing." (Q2 public participant)

"It taught me a distinction between poetry and prose, in that poetry doesn't necessarily need to have a narrative." (Q2 public participant)

"Was an interesting, inspiring and creative workshop. It opened up questioning in an area I was not aware of." (Q2 public participant)

- Provided ideas about new sources of inspiration for creativity:

"It helped me to notice the way words are connected through the sounds they create, even down to one syllable. It also made me realise that we can draw inspiration from absolutely anything, even something that at first appears to hold no interesting poetic weight." (Q2 public participant)

I had to use limited words because of the topic. It stretched my ideas, and gave me a new topic." (Q2 public participant)

"The reminder to embrace different areas of life when creating poetry. More so it reminded me of the how powerful meaning can be discerned through the mere sound of words. It can yield surprising and exciting results. Making new connections that otherwise wouldn't be made." (Q2 public participant)

"I learnt that you can write a poem on virtually anything. I also learnt a lot of words. I've always loved rhyming in poems, the challenge made it more fun." (Q2 public participant)

"Expanded my thought range of inspiration." (Q2 public participant)

"Inspiration for further poems." (Q2 public participant)

"I suppose an idea of how to start writing a poem if you are feeling uninspired." (Q2 public participant)

"Inspiration for poem beginnings. I have always enjoyed writing poems based around a single word - looking into its meaning/origins/nuances - but I hadn't considered doing it entirely on the sound of the word. It's given me inspiration for future writing. I also write a lot with reference to mythology and history, but not so much science, so this is a whole new world for me to delve into. If you take the meaning away - there's some really pretty words!" (Q2 public participant)

"I hadn't thought about how we can use the language from certain fields and professions to generate poetry." (Q2 public participant)

- Offered an opportunity to be creative:

"Inspiration to write poetry again. I hadn't written poetry for a while so it inspired me to start up again." (Q2 public participant)

"It made me be creative again in a weird way, and to just write and not focus on it too much. Which was a freeing feeling. It made me see a new avenue for creating associations in my imagery." (Q2 public participant)

"I got to explore something new, I had never heard about word associative list poems before, and I like the opportunity to explore a different kind of poetry." (Q2 public participant)

- Other artistic and creative outcomes:

"It expanded my vocabulary." (Q2 public participant)

"It has improved my ear and understanding of rhyme." (Q2 public participant)

"Helped me to broaden my vocabulary and open my mind to new styles of writing poetry." (Q2 public participant)

"Helped me think more outside of the box and expand my use of language." (Q2 public participant)

3.3. Capacity-building outcomes – new technical, artistic and personal development skills

We were interested to explore whether their involvement in OCCAT activities and events provided any opportunities for people to learn new skills. We used people's free text responses to the questions 'what did you get out of the event or activity?' and 'what might you tell friends or family about the workshop?', as a proxy for seeking spontaneous information about reflections on anything they learnt.

Public participants spontaneously reported capacity-building outcomes in the following areas:

- New skills creating artistic forms, artefacts and practices in response to HCA research
- New technical skills and practices in response to HCA research
- New personal development skills
- Development and delivery of new learning activities in response to HCA research

New skills in creating artistic forms, artefacts and practices in response to HCA research

Across all events, 78% of Q2 respondents said that they learnt new skills to present scientific ideas in a visual way, through creative writing or through use of poetry.

"The development of a poem with less of a focus on narrative was a really interesting experience. I got to experiment with a lot more visual ways of exploring the language creating mind maps and associations. It was a lot less linear than the project often is." (Q2 public participant)

For participants involved in the 'Constellations' workshops, this included skills in using creative writing for personal reflection:

"The benefit of creative writing as a tool for personal reflection in my practice as a midwife. It was thoroughly enjoyable and not something I have ever tried before!" (Q2 public participant)

"Time to reflect on moments in my career that have been intensely emotive and how this affects my practice as a midwife." (Q2 public participant)

The 'Constellations' events also provided an opportunity, and time, for practising reflective thought in the company of others:

"Time and space to think about and do some writing about my profession." (Q2 public participant)

"The importance of reflecting on emotions, remembering to take time out as our jobs are very full on." (Q2 public participant)

"An opportunity to reflect on many of my own experiences and hear from the experiences of others. An ongoing sense of the honour of doing this work." (Q2 public participant)

For those who took part in the Poetry Challenge, the opportunity to engage with a snapshot of HCA science and consider ways of responding to scientific concepts, helped participants to create new forms and styles of poetry. For some people, the OCAAT activity introduced them to a new way of writing:

"I learnt a new poetic style. Very interested and might try it again." (Q2 public participant)

"This challenge taught me about how to write more poetry using scientific language." (Q2 public participant)

"I haven't set out to write a poem that wasn't an emotive stream of consciousness in over a year. I've never written an associative word poem, or a list poem." (Q2 public participant)

"I hadn't written an associative word poem before and the process was really fun so is something that I will likely try again at some point." (Q2 public participant)

"I learned a new form of writing and got to mix poetry with my academic knowledge of science."

"I've used scientific language in my writing before but this is the first time I've written one entirely around it. I had never heard of an associative poem before, so it was really neat to gain that as a new method of writing poetry." (Q2 public participant)

For others, the new skills they learnt were transformational, helping them to develop and extend their poetic practice:

"From my perspective this challenge allowed me to realise that anything as simple as word choices can be considered a poem. It gave me the ability to work around a given word and produce one with many words combined. What I liked about this challenge is how you are able to incorporate different subjects but still produce a poem that doesn't sound informative." (Q2 public participant)

"When I write poetry, I do in when I'm in a state of flow, just writing what comes to my head. This took me out of that and made me actively have to think about what I was going to write next." (Q2 public participant)

"I hadn't heard of associative word poetry before, I thought more about how the words sound rather than

I learned about the contest on the very day it ended. I wrote the poem in about one and a half hours before the deadline, so I would be lying if I said that it wasn't a challenging experience, but it was completely worth it! I learned to write outside of my comfort zone, I have never previously written a poem in a different style than mine. Though the poem I submitted was far from my best work, I had a lot of fun writing it." (Q2 public participant)

"The challenge helped to refocus my approach to 'sounding' a poem will editing it. The focus on using scientific language gave a defined sense of structure, but also freed me up to be more playful with how words sounded while being read." (Q2 public participant)

"I got to experiment with sound, which isn't usually a focus of a lot of challenges, it is usually more often themes, so it was really interesting. As an autistic person, I find sounds and imagery soothing so it was really nice to explore sounds in this way, especially with science, which is my lifeblood as much as poetry is." (Q2 public participant)

*"It has certainly highlighted the importance of reading poetry out loud, I didn't realise HOW pivotal sound was to a poem until I had to sound out words and put them together in a poem. It has certainly helped me appreciate sound a lot more, as an under the surface kind of technique in poetry. It is funny how sound is so in our face yet is often overlooked when we write despite how *there* it is." (Q2 public participant)*

New technical skills and practices in response to HCA research

Some public participants mentioned new technical skills and practices they had developed as a result of involvement in OCAAT events. For instance, of the 50 Schools Card Game Challenge

entrants responding to the Q2 questionnaire, 82% said they now knew more about designing a card game:

"I really enjoyed learning about new things in this way and creating my own card designs!" (Q2 public participant)

"I might try found out more about the immune system and its functions as I found it really interesting when I researched it for my card game." (Q2 public participant)

For people who took part in other OCAAT events, new technological skills involved learning about how different ideas can be presented online, how to create an augmented reality environment and use of scientific datasets for artistic exploration.

"Ideas about how different ideas could be represented in an online format." (Q2 public participant)

"How to create augmented reality." (Q2 public participant)

"I sort of, you know, expanded my knowledge of what the current technologies are. And also, some of those datasets that are, you know, available, that, you know, are available for utilitarian or, you know, artistic exploration." (Q3 public participant)

For some of the students involved in workshops, new skills included making sections from vegetables, macro-level photography of these sections and creating digital images of cells from the sections. Students also learnt how to manipulate these images using appropriate software.

"Yeah, they would have with the photo taking and the imagery. I think a few of the boys had probably not used a potato peeler - very basic. I think we did actually have a cut finger from memory." (Q3 public participant)

"How to slice a vegetable without - you know, all that physical stuff. And how to photograph it at a macro level. How to turn that - what they were good at, and probably...is using either Photoshop, or a thing, to try and master - I don't know if that's the right word. But digitalising the cell in, say, Photoshop, and how they made it as a smart object, to then put it into this. So I think it goes - they learnt about the digitalisation of a cell, and then how does that get put into something like the Godot software, and then how the pattern it makes, kind of like a very 8-bit Nintendo looking Metroid." (Q3 public participant)

New personal development skills

A few public participants also noted some new personal development skills through their involvement in OCAAT events. For example, of the 50 Schools Card Game Challenge entrants who responded to the Q2 questionnaire, 58% said they knew more about the different roles of people in a team.

"I thought that it was very fun to be part of a team, and I really enjoyed making the card game." (Q2 public participant)

The concept of collaboration and developing skills in teamworking was also highlighted by some of the teachers involved in the Card Game Challenge.

"There's obviously collaboration. In this case, because of the way it had to be set up because of the pandemic, it was between the little one and the sixth-former. But there are a couple of scenarios where lower school students worked together, and they really felt that that was part of it, the partnership, so the collaborative element." (Q3 public respondent)

Teachers also thought that the Challenge had enhanced their students' literacy skills and given them an opportunity to practise resilience, within the context of working on a complex task and developing and refining a finished product for submission to a national competition.

“And I guess there's a literacy element to it, so there's a broader, more complex range of terminology being brought to their projects, which they wouldn't otherwise be familiar with. So they could ultimately end up writing in a more technical way as a result of being involved in the project.” (Q3 public respondent)

“They did find it very difficult, so the fact that they were patient and persisted with it, and showed some sort of - resilience, again, is another word I don't like to use, because it's not easy to define. But I think the project brief, together with my high expectations, meant that they wanted to deliver something that they would be proud of. And I did give them feedback, I gave them feedback on their drafts, and I've got to say the girls were so impressive in the way that they addressed that feedback and were able to move the project forward. So I guess, yeah, they were resilient, and, as a result, probably more reflective, because maybe they had never been involved in such an iterative process, where the first idea looked very different from the last.” (Q3 public respondent)

Some of the Poetry Challenge participants described how they had a better understanding of their personal potential for creativity and were more open to the idea of sharing their poetry in the future.

“It helped me understand my potential for poetry and creative writing as a whole.” (Q2 public participant)

“It ignited a creative spark, which I had been lacking due to the demotivating lockdown.” (Q2 public participant)

“It allowed me to see that poetry can be used by anyone, not just literature scholars, and there is a huge variety of topics you can explore in your writing, expanding your style.” (Q2 public participant)

“I might be more willing to share my poetry going forward.” (Q2 public participant)

Development and delivery of new learning activities in response to HCA research

For the teachers involved in OCAT activities, there were a few additional capacity-building outcomes noted. One teacher explained how she extended the scope of the science covered by the challenge, both for herself and her students:

“I did try and integrate extension to the project, because I felt in this context that sticking to cell structure and cell specialisation and cell architecture was a little bit limiting. So I wanted to take it to the next level, even with key stage 3 students. But what I was pushing them towards were things like cell signalling and gene expression. And that is a huge leap. So to try and make those extra bits accessible to my little ones was tricky.” (Q3 public participant)

Others described how they learnt new skills to use creativity to enrich the science curriculum meaningfully during remote teaching and learning. In one school, the Biology department and Art and Design departments worked together to deliver and support the card game challenge, learning from each other's skills and expertise:

“I did actually involve the art department in short-listing the entries. Because I felt I quite like the hand-made feeling of things, but they were more informed on graphic design. So they helped me understand more about what had been successful from an aesthetic point of view. So that there is certainly a lot of artistic skill that has been used to develop the aesthetic and the theme, and how the card game would feel if a player was playing it.” (Q3 public participant)

3.4. Instrumental/behavioural outcomes – changes to behaviour, actions or practice

We were interested to explore any impact of OCAAT events on people's behaviour, actions or practice, particularly following their engagement with HCA research. At Q2, we asked, for instance, if participants were interested in being involved in this sort of activity again. Responses (n=57) showed that 84% were interested, 11% said they 'may be' interested, whilst 5% were not interested.

“The Human Cell Atlas Challenge was the first writing contest I've ever entered, and it encouraged me to participate in others.” (Q2 public participant)

"I will look out for similar initiatives in future." (Q2 public participant)

"In the future, I will enter more competitions hosted or write more poems overall." (Q2 public participant)

"In the future, I hope there will be more opportunities like this and I plan to take them up!" (Q2 public participant)

"I will definitely consider partaking in more competitions, I think I'll spend more time thinking about how my scientific knowledge can impact my work in literature and film in the future." (Q2 public participant)

By way of further evidence, many people said they wanted to generally keep in touch with the OCAAT project and events.

"I plan to watch the live events streamed and to consistently visit the exhibition website over the next month when I need a little bit of inspiration." (Q2 public participant)

"I'd be interested to see the development of the project and learn about future projects linking the arts and science." (Q2 public participant)

"I would like to know more about how the artistic collaboration develops." (Q2 public participant)

"Go through all the exhibits." (Q2 public participant)

"I have already visited the website, looked at the project lead's bio info in-depth, and even been inspired for my upcoming workshops for lesson plans and activities for children." (Q2 public participant)

At Q2, we also asked participants if they thought they might talk to family or friends about the event and/or the Human Cell Atlas. Of those who responded (n=303), 58% said they were definitely planning to start conversations with family members and peers about the impact and potential of research and the HCA project, and 70 of these respondents provided more detail in their free text answers. 22% thought 'maybe' they would do so, 9% said they didn't know, and 11% said they would not do this. In addition, 67% of Q2 respondents provided examples (in 207 free text responses) of things they were planning to do or find out more about following their engagement in OCAAT events and activities. Analysis of these two sets of free text responses, alongside data from Q3 interviews, highlighted a number of key instrumental outcomes for participants, as outlined below.

Human Cell Atlas and scientific research

Many participants simply expressed their wish to find out more about the Human Cell Atlas initiative itself:

"Set up a google alert for Mapping Atlas." (Q2 public participant)

"I'd like to track the Human Cell Atlas project a bit." (Q2 public participant)

"Explore HCA website, look at mapping body." (Q2 public participant)

"I will continue to follow the Human Cell Atlas work." (Q2 public participant)

"I will continue reading about the Human Cell Atlas in the future." (Q2 public participant)

For some this linked to a professional interest: for instance one teacher was planning to use HCA research to develop a deeper understanding of the structure and function of the skin as an organ and try to integrate this into GCSE teaching of homeostasis and the nervous system.

"I'd definitely like to get involved with Human Cell Atlas Project and do as much as I can as a medical student." (Q2 public participant)

"The Human Atlas, The Wellcome Collection and writing about my experiences as a doula." (Q2 public participant)

For others the interest was more in a personal capacity:

"I would definitely like to hear more about the HCA project and its findings. I really enjoyed looking at the histological stains and the gene-expression images that were shown at the start of the workshop and I genuinely think they would look great as framed posters (I'm a big fan of abstract visual art). ." (Q2 public participant)

"I am intrigued about everything scientific, I plan to be a paediatrician when I am older and I feel that learning more about the importance of different cells is a crucial step forward." (Q2 public participant)

"I think that although it was hard the challenge was engaging and inspired me to find out more about the Human Cell Atlas." (Q2 public participant)

Several people said they were intending to conduct their own research in areas of interest that the HCA science had inspired:

"Research more into different scientific processes and follow and research more into the artists involved." (Q2 public participant)

"I would love to find out more about Michael Mather's research as I have in the past had an abnormal amount of ear infections and would like to know why." (Q2 public participant)

"I might do some research on the different functions of cells in the body." (Q2 public participant)

"I will follow the project and carry out my own research in areas that the workshop has created an interest in." (Q2 public participant)

"Find more about how the cells communicate." (Q2 public participant)

"Next, I may do some more research involving science and the human body." (Q2 public participant)

"I might do more research on the project." (Q2 public participant)

"I might do more research on human cells." (Q2 public participant)

Some others were keen to explore more connections between art and HCA science:

"I want to understand more about the scientific project and keep in touch with these explorations of how to design education and understanding experiences for the public." (Q2 public participant)

"Seek out more information about the Human cell atlas and events connecting art and science." (Q2 public participant)

"Continue to read about the research undertaken for the HCA, reading more about the human microbiome, think more about the different ways of interpreting the scientific research as an artist/ designer." (Q2 public participant)

Several of the students involved in OCAAT events and activities were inspired by the science to find out more about human cells and biology. Their comments below are evidence of the intensity of their engagement with HCA science and the sophistication of the understanding they developed:

"I might make a map of a body with the basic cells on it." (Q2 public participant)

"I would like to find out my about the cells in the world (not just animal and plant) and learn which cells in the human body do what to help us survive and live." (Q2 public participant)

"To find out more about all the different organs and our complex body." (Q2 public participant)

"I would like to learn about more the different organs and their cells." (Q2 public participant)

"I might try find out more about the immune system and its functions as I found it really interesting when I researched it for my card game." (Q2 public participant)

"I might find out more about what kinds of diseases affect which cells and how the diseases are overcome." (Q2 public participant)

"I think that I am very interested in how cells work together to form a bigger picture. I will continue to learn about this." (Q2 public participant)

"I enjoyed researching about the human body and will continue to use that knowledge." (Q2 public participant)

Tissue and organ donation for research

Figure 10 data (see page 33) shows that 41% of Q2 respondents said they were planning to have more conversations with friends and family around research and tissue/organ donation (19% had already done this irrespective of their involvement with the project). People's qualitative Q2 and Q3 responses suggested that sharing information about their wishes, and finding out about the wishes of others, were key areas for these conversations, some of which had already happened:

"But I'm very keen to just contribute and participate in in any research and anything I can do to help the world. So you know, if there's a way that my body can be used, when I've died, then I would. And I think my family, I spoke to my family about the workshop after I had it. And so we all talked about donation and things. So you know, my wishes, hopefully are clear with them. So I guess I've made that little tiny step." (Q3 public participant)

"My decisions, ask about theirs, tell them about the project." (Q2 public participant)

"My wishes, explore their thoughts and feelings regarding my death, will talk about the 'pack' and how I am interpreting it." (Q2 public participant)

"I will encourage discussion around the opt in donor system and find their views." (Q2 public participant)

"Talk to family about my wishes for organ/tissue donation. Make this know on the NHS app." (Q2 public participant)

Other areas for potential conversations with family and friends included the HCA research itself and the creative dimensions of One Cell At A Time:

"I will end up talking to them about the whole experience because it was unusual and interesting. It would not make me tell them to donate or not to donate, and to be honest, I have no idea how you donate anyway (is it the same as registering as an organ donor??) but it would make me talk about what the Human Cell Atlas is about - I think it will lead to some interesting discussions." (Q2 public participant)

"I might look into tissue donation further. Interested as well in conversations around the creative dimensions of the project." (Q2 public participant)

Other instrumental outcomes for participants in relation to organ and tissue donation included plans to clarify wishes relating to organ and tissue donation generally and for research purposes and plans to do more fact-finding in this area to better inform decision-making.

"How to add to my will my wishes." (Q2 public participant)

"I'm going to check my organ/tissue donor registration and that of my husband." (Q2 public participant)

"Finalise my donation plans." (Q2 public participant)

"I might find out more about tissue donation." (Q2 public participant)

"Donating medical data." (Q2 public participant)

"I might want to know to what extent organ and tissue donations are essential for research, how they are disposed of (following huge recent scandals in France for instance), how to put emphasis on transparency, how to encourage the data to be shared in an open-source fashion or as a way to give back to the community." (Q2 public participant)

Scientific (STEM) and medicine career pathways and opportunities

In terms of instrumental outcomes, there was a small amount of evidence showing more interest in science and medicine subjects and career pathways, amongst students, teachers and other participants.

"My children get a science magazine which I never read and was about to end the subscription of - I might actually read it and keep up the subscription for me! Perhaps it will tell me more about things like the HCA." (Q2 public participant)

One teacher said they would investigate more diverse career options with their students; and a few students expressed an interest in exploring STEM career pathways:

"I have a duty to showcase the variety of skill amongst the scientists that are working on this project to my students, to diversify their aspiration." (Q3 public participant)

"I would like to find out more about famous female careers in science, as I have found a few shocking statistics generally about how little women work in the Scientific Community due to lack of confidence or worries of being judged. I would also like to find out about the use of Art in Science, as I feel there is definitely a place for it, hence S.T.E.A.M being used instead of S.T.E.M." (Q2 public participant)

"I will do some research into jobs in biology and also look for ways in which I can contribute to the scientific community." (Q2 public participant)

"Researching careers in biology." (Q2 public participant)

"I'm going to further my goals in doing biology in the future." (Q2 public participant)

"I really want to find more about how cells function and how they work together in the body. I also want to find out about jobs in this area." (Q2 public participant)

Outcomes in this area were not just STEM related: for one person, involvement in an OCAAT activity had encouraged her to consider a new career pathway in creative writing.

"I am more likely to focus on creative writing as a possible career in the future." (Q2 public participant)

And for one group of students and their teacher, engagement with One Cell At A Time provided exposure to the potential career pathways associated with the gaming industry, in ways that the students had not previously considered.

"And I do think that students probably, in terms of pathways, might think, Oh, actually, gaming and gaming engines doesn't have to be used to play a video game; it can be used in science, it can be used in algorithm, it can be used as a visual tool for something else. So I think that was something they'd probably never thought of ... Because we know, obviously, that all sorts of people use algorithms - use technology to help. And I think that maybe they'd not thought about how "gaming engines" can be used in different ways. And that would be a cool pathway." (Q3 public participant)

The ways in which the OCAAT project had demonstrated the value of combining science and creativity, and the potential for this in terms of future career pathways was highlighted by OCCAT team members too:

"In the field of design, you're always combining art and science and creativity and science. So it's not ground-breaking in that sense. A lot of design processes are based on fact and science and research. And I think at school that's often quite lost in the education system. It's very divided. And people often think, Oh, art is less academic or something, but design kind of brings all of that together. So yeah, I think it's great." (OCCAT team member)

"I think people have different learning styles and ways of engaging, and you're cancelling people out at an early stage, if you're only teaching science in one certain way. So people who actually might be great at science and really bring that creative mindset just switch off by the dry learning style, possibly." (OCCAT team members)

"You tend to find in the fields of science and medicine the people who are actually the innovators are the people who actually are the creative ones as well, because they managed to learn all of the subject matter, but also managed to retain a sense of wonder." (OCCAT team members)

Art, dance and creativity

There were three main types of instrumental outcomes mentioned by participants in relation to art, dance and creativity. Firstly, a few people said they planned to find out more about other artists and creatives working with the HCA and more widely:

"I want to look more into the other artists participating in the project too!" (Q2 public participant)

"The other artists, more about how people are representing these complex systems." (Q2 public participant)

Secondly, there were a few examples of people wanting to find out more about art/science as an engagement approach:

"I'll seek out info on art engagement as a boundary object between science & public and will consider how my own practice can contribute." (Q2 public participant)

"Using art/creative movement to explore well-being and health and support people to be seen, to have a voice for what they are experiencing." (Q2 public participant)

"I might use this kind of challenge when I lead workshops." (Q2 public participant)

"I will definitely take this thinking into my future practice." (Q2 public participant)

Thirdly, and most significantly, participants expressed a wish to continue to do more creative and artistic work, including continuing work they had started during OCAAT activities and events in the following areas:

- Poetry and creative writing:

"Tell mentees and colleagues about the importance of writing down their experiences and feelings after witnessing intense births." (Q2 public participant)

"I'd like to get more midwives involved with writing; it feels like the right thing to do." (Q2 public participant)

"I am very interested in further exploring associative word poetry, which I hadn't heard of before the challenge, and looking into how I might further use scientific language in my writing." (Q2 public participant)

"From the experience of creating my poem through the Human Cell Atlas Challenge, I'm taking the same editing approach to an anthology of poetry I'm currently compiling in order to better create a sense of fluidity in my work. It was a very useful exercise for me in terms of defining what I really enjoy in a poem." (Q2 public participant)

"I might challenge myself with responding to some prompts and redrafting poems that I've written to actually build up a representative poetry portfolio." (Q2 public participant)

"Next, I might write a short story to keep the imagination going." (Q2 public participant)

"I've been trying to incorporate STEM concepts in my writing because I find it fascinating to craft metaphors with them and it gives me a reason to pay attention in those classes, and I expect I'll be trying to continue doing that." (Q2 public participant)

"I will continue writing in this field but with more awareness of the medical/ scientific language surrounding it." (Q2 public participant)

"One thing that I might do next is try and write more creative/narrative pieces and see how I feel about them." (Q2 public participant)

"I'm probably going to go on to write more word-association poems, maybe based on geology (my field of study). I like the mixing of science and art a lot." (Q2 public participant)

"I am going to try and write about my experience of looking into the world of microscopes." (Q2 public participant)

"I might concentrate more on writing poems in more unconventional topics now, thanks to you!" (Q2 public participant)

- Cells, patterns, movement and dance:

"Looking at patterns more closely." (Q2 public participant)

"I'd like to do more with patterns in art and dance." (Q2 public participant)

"Thinking about patterns and pattern matching. connecting movement and sound." (Q2 public participant)

"I'd love to create some different types of art influenced by cellular ideas." (Q2 public participant)

- Game creation and use of data:

"Will continue some of the work I've done in the Maker Jam." (Q2 public participant)

"I might do more data wrangling and more art projects using the data, tools and ideas explored in the Maker Jam." (Q2 public participant)

"Continue to develop the work I have made in response to the Maker challenge and have another look at all the artists' challenges (they all sounded really interesting!)" (Q2 public participant)

"I might try making other styles of my own games again!" (Q2 public participant)

"I might start making more games to do with science." (Q2 public participant)

3.5. Connectivity outcomes – new connections and relationships

There were no specific questions about connections and relationships at Q2, but people noted connectivity outcomes in their open responses to other questions 'what did you get out of the event or activity?' and 'what more might you do or find out about?'. Key outcomes in this area included:

- New connections developed with a variety of colleagues across disciplines who are interested in creative collaboration

"It was a fun challenge to focus on the feel of the word rather than the images, and it was actually really hard for me! It was also neat to swap and edit poems with an acquaintance of mine (who I worked with for the collaborative challenge) and see her take on this challenge." (Q2 public participant)

"Great concept, it was a fun week, opportunities for collaboration and connecting to people from different disciplines." (Q2 public participant)

- New forms of collective creativity developed

"It's been over a year since I've been in any sort of Maker Jam kind of things. And, you know, being part of, I guess, you know, a little community for a while is very nice. Yeah. Also, it's maybe not so much about learning new skills, but

identifying the other people who have skills that you could, you know, work with or collaborate with later.” (Q3 public participant)

- Connections developed between artists and scientists

“An idea of the collaboration and community, not only behind HCA but between scientists and artists. I think this exhibition showcases some of the most important topics in healthcare and scientific research in our current times. HCA will be a vital part of understanding and treating disease, and this exhibition means that people will know about this and ignite a passion for science that might not have previously been known. Combining art and science is a great way to get the message further, and these two disciplines share more than most people think. In addition to this, this exhibition can help bring young minds into science and art and inspire the next generation of creative thinkers.” (Q2 public participant)

“Calming and safe experience to socialize and be exposed to art. I also thought everyone involved was warm, open, excited about the projects/art and it was a much needed 'virtual hug' - interacting with these types of attitudes and personalities was a wonderful way to finish my week/Friday. THANK YOU.” (Q2 public participant)

“I shared it with my partner, and also sent the link to about 10 of my friends. I really enjoy the intersections of art and science and these two communities and types of people collaborating. I was excited and also truly enjoyed the evening.” (Q2 public participant)

“It's exciting when scientists and artists and community come together with curiosity (not all as 'experts' but as people who are exploring and trying to better understand).” (Q2 public participant)

- Plans to stay in touch with some of other participants:

“Would be interested to hear/ see more of the participants work and where the project goes next.” Would be interested to hear/ see more of the participants work and where the project goes next.” (Q2 public participant)

“Follow up a personal connection.” (Q2 public participant)

3.6. Affective outcomes – sensory, emotional and experiential responses

One Cell At A Time events and activities had significant affective impact on those involved. Quantitative findings at Q2 indicate that 96% of respondents enjoyed being involved in creative activities and 81% enjoyed expressing their ideas, thoughts and concerns through art and creativity. 87% said it felt fun to learn about science and the Human Cell Atlas in this way.

Figure 12 presents an overview of the 30 most frequently cited words in answer to the question: ‘how did the workshop/activity/event make you feel?’. The word cloud shows the sheer range of emotional reactions to OCAAT engagement activities. People felt ‘inspired’, ‘interested’, ‘happy’, ‘excited’ and ‘creative’. They ‘enjoyed’ the activities and found them ‘fun’ and a ‘challenge’. They felt ‘involved’, ‘engaged’, ‘informed’, and ‘connected’.

Participants’ spontaneous open responses at Q2 and Q3 build on these findings and highlight the range and diversity of emotional outcomes experienced as a result of their engagement with One Cell At A Time, as the sections below present.

Figure 12: Public participants' post-event perceptions of affective outcomes (Q2 n=193)



A sense of fun and enjoyment

"Enjoyed being creative and it helped me use my creativity in a new way."

"It was fun. enjoyed the idea of making a poem linked together by sound."

"I am in a non-creative job, so enjoyed indulging in my creativity. Out of my involvement, I got the satisfaction of producing a creative piece that felt official; it was a creative output, rather than just my creativity bubbling over into some unedited lines. This felt extremely satisfying, even if I didn't spend as much time or gain as high quality an end product as I'd like."

"The skill of having fun while writing poetry." (Q2 public participant)

"I thought that it was very fun to be part of a team, and I really enjoyed making the card game." (Q2 public participant)

"It was very fun and satisfying to bring my passions for poetry and science together." (Q2 public participant)

"I really enjoyed writing and learning about something I wouldn't normally learn/ write about." (Q2 public participant)

"I enjoyed it a lot especially brainstorming and putting my ideas into life." (Q2 public participant)

Excited by the activity and the work of the Human Cell Atlas

"Excited, interested in finding out more about the science of the HCA project, a little bit overwhelmed at points (there was a lot of information to take on board), connected to other people." (Q2 public participant)

"I found it exciting that I am getting involved with something that is creative and does outside of school or where I live." (Q2 public participant)

"It was exciting to be writing a poem in response to a project that is so intriguing and perhaps will advance human consciousness of self. it was such a fun way to productively use my time rather spending my evenings on the Xbox." (Q2 public participant)

"It was exciting to think of poems in this new way - as organisms, with each word acting as a cell." (Q2 public participant)

Happy, positive, relaxed, calm, reassured

"Happy that I was part of a group project." (Q2 public participant)

"The creative aspects made me feel at ease and relaxed." (Q2 public participant)

"Calm - I found the physical part of the workshop therapeutic." (Q2 public participant)

"I got experience in participating in the challenge which made me feel good because there is not much we can do at the moment." (Q2 public participant)

"Happy! Got a great sense of achievement from my poem." (Q2 public participant)

"Made me feel happy, relaxed and inspired." (Q2 public participant)

"Happy and it gave me something to do each day." (Q2 public participant)

Interested and informed

"Interested in how it must feel to be a donor or a recipient of a donated organ interested more generally in giving and receiving." (Q2 public participant)

"I enjoyed it and left feeling more informed than before. It also made me aware that public knowledge of donation and research could be improved." (Q2 public participant)

"Interesting to hear peoples experience of the enquiries that have been going on, interesting to see the responses that artist/scientists/community create together, interesting to hear what people found interesting and where they took this." (Q2 public participant)

Curious and a wish to discuss and explore further – inspired to be creative, whilst being challenged – development of new perspectives

"Relaxed, curious and brought up lots of thoughts and questions, a desire to explore more." (Q2 public participant)

"It made me curious what there might be to come and how this creative, very different approach will result into an outcome - very much hoping that this will find its way into more discussions." (Q2 public participant)

"Inspired by how the research was represented in a variety of different ways." (Q2 public participant)

"I felt like I saw the science I knew from a new perspective." (Q2 public participant)

"Galvanised, exhilarated, curious, connected, out of my comfort zone, wanting more of the same, determined to overcome my challenges with the digital." (Q2 public participant)

"Refreshed, stimulated, engaged and otherwise good to keep grounded on progress coming on." (Q2 public participant)

"Reflective on life and death, privileged to share other thoughts, opinions and stories and inspired to use my art to communicate my thoughts to the questions." (Q2 public participant)

"It made me want to know more about the science, the artwork and I felt I need to discuss it with family.

It opened up questions that I didn't think about before." (Q2 public participant)

"It made me think hard but I felt great." (Q2 public participant)

"It felt so freeing and fun." (Q2 public participant)

"I have been inspired, too, to play around with words I didn't actually know, and not to be afraid of this. I feel like there is suddenly a lot of new possibility in fields of research I felt were out of my depth. To some extent, I now feel that a door has been opened, and that I can take from these materials things whatever I like - it doesn't have to be a comprehensive understanding of the research conducted - a new word or a new awareness of the existence of something is enough to inspire lots." (Q2 public participant)

Emotionally and intellectually moved and engaged

"I don't think I'd ever heard such, I've never felt so close up and involved as I did listening to those people. That was I found it rocked me. I didn't sleep that night. It was powerful stuff." (Q3 public participant)

"It's not individual words, it's how they sound together - they can evoke a certain feeling and make someone feel discomfort or relaxation." (Q2 public participant)

"I enjoyed challenging myself to write when I had been struggling to motivate myself to do so for a while; out of the challenge, I got a reason to get back to the paper. It made me process some of the things I had been feeling, and by incorporating them into what I was writing, it helped me create something positive out of what had been a series of negative emotions, and I felt relieved and happy to have done this." (Q2 public participant)

"Relaxed, open, dreamy, reflective, inspired." (Q2 public participant)

"Impressed and moved by the personal experiences." (Q2 public participant)

"It made me feel cool that there's a chance that we could educate the next generation in a card game." (Q2 public participant)

Connected, inclusive, listened to, valued – empowered by having a voice in a wider project

"Being involved with the card game made me happy as it helped me reconnect with my friends whilst learning new things about the human body. It helped me talk to people more, because of Covid-19 I had stopped socialising as much as I wanted to." (Q2 public participant)

"It made me feel part of something much bigger than just an ordinary school competition." (Q2 public participant)

"Happy because it felt great to be in a team where everyone counted equally." (Q2 public participant)

"For me, being involved in the card game challenge felt meaningful, as I was a part of something that could help develop science, and our knowledge of it." (Q2 public participant)

"My involvement in this challenge made me feel part of a group of like-minded people who have an interest in poetry, language and making new discoveries." (Q2 public participant)

"Made me feel part of something bigger than myself and my own writing." (Q2 public participant)

"Created a positive collectivity of thought and action." (Q2 public participant)

"As if you are taking part in something very important." (Q2 public participant)

"Created a feeling of community as important, humanity as important but I couldn't shake the question of why the focus is all on making more medicines. No mention of prevention or what we could discover about the human body's natural healing potential, ability to self-regulate, find health." (Q2 public participant)

"Listened to. Valuable." (Q2 public participant)

"It's great to be part of a much bigger, important, picture." (Q2 public participant)

"I enjoyed it and thought that it was good to do something different and work as a team." (Q2 public participant)

"That my words and experiences are powerful." (Q2 public participant)

"It made me feel really welcomed and included." (Q2 public participant)

Proud, grateful, fulfilled – the feeling of achieving something

"I was nervous to have to perform but felt very comfortable doing it and I'm grateful to have been invited to participate." (Q2 public participant)

"Grateful for the openness of the participants and those who initiated the project. Happy that there are opportunities like this for science and the arts, and specifically dancers to collaborate... one thing that has stayed with me is Anna talking about bringing the experiencing in and of our bodies to scientific research that is about the body!" (Q2 public participant)

"I felt proud to be a part of it." (Q2 public participant)

"Proud of my work." (Q2 public participant)

"It was also the first time I ever entered a poetry competition or submitted a poem externally, and so my involvement made me feel very happy and proud of myself." (Q2 public participant)

"Really well explained project. I knew immediately that I wanted to give this challenge a go. I finished the experience inspired and proud of what I had managed to create." (Q2 public participant)

"It made me feel capable and but also fun since it was open to one's creativity. I like how there was no restrictions but more uniqueness." (Q2 public participant)

"It made me feel fulfilled to write and share a piece of my work. Super fun." (Q2 public participant)

Negative affective responses to OCAAT events

Whilst the vast majority of affective outcomes were positive, a small number of participants also expressed some negative sensory, emotional and experiential responses in terms of feeling confused, disturbed, embarrassed, vulnerable and in one case, isolated:

"A bit inadequate. It felt like I was supposed to know what to do, but I didn't. I think the project is very cool, and I was excited for the workshop, but I found the workshop itself quite hard." (Q2 public participant)

"It was interesting, but emotionally disturbing I found the Zoom experience on my iPhone made me feel isolated, and unconnected to the other participants." (Q2 public participant)

"Confused. Interested, tired, a little embarrassed." (Q2 public participant)

"Overwhelmed by sadness and loss. My family experience of suicide made me feel separate from those experiencing loss and the threat of loss because of physical pathology." (Q2 public participant)

"Quite vulnerable! I love writing and workshops but I get a massive vulnerability hangover every time I take part." (Q2 public participant)

"Interested, nervous, a bit confused, relaxed, soothed but worried." (Q2 public participant)

"Writing the poem was very stressful and difficult for me, I thought a lot about giving up in that short time span, but I am a very determined person so I kept on going and I don't regret it." (Q2 public participant)

"At time stressed and annoyed but after it all I felt a sense of accomplishment." (Q2 public participant)

3.7. Summary of outcomes for public participants

The evaluation data collected from public participants of One Cell At A Time events and activities indicates that the following short-term outcomes were achieved:

Attitudinal outcomes

- Positive changes in attitudes (in terms of value and trust) towards scientific research, the Human Cell Atlas and science more generally
- Positive change in attitudes and new perspectives in relation to organ and tissue donation and its use in HCA/biomedical research
- Increased respect for the value of tissue donation for HCA/biomedical research
- More willingness to discuss wishes around research and tissue donation with families and friends
- Positive impact on attitudes towards art/science led approaches, methods and resources

Conceptual outcomes

- Increased knowledge about HCA research and how it is conducted
- Increased understanding of how they can contribute to HCA research
- Increased awareness of the value of their potential contributions to HCA research
- Increased awareness and understanding of how HCA research affects them now and in the future
- Increased understanding of human cells and how the body works
- Greater awareness of the scale and global reach of HCA research
- Increased knowledge of scientific terminology and broadened understanding of science more generally
- Increased knowledge and understanding of tissue donation for research, particularly within the context of the Human Cell Atlas
- Increased understanding around consent, data sharing and ethical issues in relation to tissue donation for HCA research
- Increased awareness and understanding of the varied STEM and medicine career opportunities and pathways available
- Understanding of the value of bringing art and science together to discuss complex issues
- Increased understanding of how art and science intersect to explore new meanings, practices and patterns

- Expanded understanding of the nature of different forms of art, dance and creativity
- New ideas about sources of inspiration for creativity
- Opportunities to be creative

Capacity-building outcomes

- New skills creating artistic forms, artefacts and practices in response to HCA research, including skills to present scientific ideas in a visual way, through creative writing or through use of poetry
- New technical skills and practices in response to HCA research, including skills in how to design a card game
- New personal development skills, including increased understanding of team roles
- Development and delivery of new learning activities in response to HCA research

Instrumental/behavioural outcomes

- Continued engagement with the project and/or similar activities in the future
- New conversations with family members and peers about the impact and potential of research and the HCA project
- Empowered to find out more about the HCA
- Empowered to conduct their own research in areas of interest that HCA science had inspired
- Empowered to explore more connections between art and HCA science
- Inspired to find out more about human cells and biology
- More conversations with friends and family around research and tissue/organ donation
- Plans to clarify wishes relating to organ and tissue donation generally, and for research purposes and to do more fact-finding in this area to better inform decision-making
- Greater interest in science and medicine subjects and career pathways; and in creative and artistic career pathways
- Find out more about other artists and creatives working with the HCA and more widely
- Find out more about art/science as an engagement approach
- Continued creative and artistic work, including continuing work started during OCAAT activities and events in the following areas: poetry and creative writing; cells, patterns, movement and dance; game creation and use of data.

Connectivity outcomes

- New connections developed with a variety of colleagues across disciplines who are interested in creative collaboration
- New forms of collective creativity developed
- Connections developed between artists and scientists
- Plans to stay in touch with some of other participants.

Affective outcomes

- A sense of fun and enjoyment
- Excited by the activity and the work of the Human Cell Atlas
- Happy, positive, relaxed, calm, reassured
- Interested and informed
- Curious and a wish to discuss and explore further – inspired to be creative, whilst being challenged – development of new perspectives
- Emotionally and intellectually moved and engaged
- Connected, inclusive, listened to, valued – empowered by having a voice in a wider project
- Proud, grateful, fulfilled – the feeling of achieving something.

4. Outcomes for HCA members

HCA members were involved in One Cell At A Time events and activities as participants, co-facilitators, and presenters. This chapter explores the ways in which HCA members responded to the engagement activities, events and resources and examines the data for any evidence of changes to their attitudes, skills, knowledge, behaviour, connections and emotional responses.

4.1. Attitudinal outcomes – changes to attitudes and motivations

Changes to perceptions and attitudes towards public engagement with HCA research

The Q1 and Q2 questionnaires to HCA members asked: ‘what words come to mind when you think about public engagement?’. HCA members’ free text answers show that before their involvement in OCAAT activities (see Figure 13), public engagement was perceived as ‘fun’, and about ‘information’, ‘communication’ and ‘dissemination’. They also mentioned that it could be ‘exciting’ and involved ‘collaboration’ and ‘openness’.

Figure 13: HCA members’ pre-event perceptions of public engagement (Q1 n=32)



After their involvement in OCAAT activities (see Figure 14), HCA members described public engagement primarily as ‘fun’, but also as ‘creative’ and about ‘art’. They also talked about the ‘interesting’ and ‘inspiring’ nature of public engagement. Notably, perceptions of public engagement as ‘communication’ and ‘information’ was significantly less prominent in HCA member responses at Q2 than at Q1.

Figure 14: HCA members' post-event perceptions of public engagement (Q2 n=23)



Qualitative data from Q3 interviews with HCA members and from interviews with OCAAT team members (some of whom are also HCA members) corroborated these Q2 findings. Interview data showed that there was increased willingness to view public engagement as a two-way opportunity to seek multiple perspectives, and to have a dialogue with a range of public communities.

"I think there has been quite a big shift in terms of how [HCA Members] view public engagement. Historically, what I've noticed is it hasn't seemed like a two-way street, it's seemed like a very one-way, information-giving exercise, whereas now they're seeing the benefit of engaging these people and getting that different perspective." (OCAAT team member)

"And I think, quite significantly, they are really thinking beyond that transactional, one way, knowledge transmission, protocol, that often is the way for science-led public engagement, and really thinking about that active dialogue, that can be facilitated from a range of different perspectives and in a range of different ways." (OCAAT team member)

"For me, it's that shift in mindset from the scientists to really consider public engagement, consider different ways of presenting their information to different people and seeing that it's a two-way street, not just a one way I am telling you what I'm doing type thing." (OCAAT team member)

Interview data also indicated that HCA members were increasingly willing to consider using different methods for engaging communities and felt more confident and motivated to do so.

"So from my point of view, individually I've found it's been very useful to see a different perspective on how to present work, I think. So a lot of the type of engagement we do historically, especially within science, has been - it's very structured and one-way. You know, you go to a classroom, you explain the concepts of science, and then get people to do some sort of activity, and, 'Yay, OK, you've learnt some STEM. Hopefully you'll come and do that later on.' But having the arts side of it come in has really shown how you can give that same information in a much different way, to reach audiences that you wouldn't have thought you'd be able to reach. So personally I found that quite amazing, because it's not something I would have actually considered myself, had we not been part of this project." (Q3 HCA member)

"You know, and science is beautiful. But sometimes we forget that it's beautiful. And, you know, I think this whole event for me has been so two way. So it's like we're conveying information. But we're also listening back because what does the public want to know about? And how do they perceive and how do they understand what we're talking about?" (HCA member)

Overall, there was robust evidence to show that, as a result of their involvement in One Cell At A Time, HCA members were simply more willing and enthusiastic to engage and communicate with different public groups about HCA research.

“Definitely. I just wanted more, like, I just kind of had the challenge to find the time to do it more. But I really, really enjoyed this. I find it really interesting. And I always have in mind that I would have loved that when I was a child.” (Q3 HCA member)

“I’m hoping that it will inspire other scientists to want to communicate their research as well. So it’s not just this one off thing, it would be really interesting if, if more researchers actually communicated their research in whatever way they like, but ways which they think will engage people who are outside of science, but taking interest.” (Q3 HCA member)

“There’s definitely more engagement now. People are more enthusiastic to do more. There’s more recognition of the importance of public engagement. And there have been tremendous efforts put into finding communities to engage with.” (OCAAT team member)

Increased respect for the value of tissue and organ donation for research

Interview data from HCA members and the OCAAT project team highlighted some examples of increased respect for the value of organ and tissue donation for research, which came about through open dialogue between HCA members and public communities. One HCA member suggested that, significantly, the project had facilitated the use of more thoughtful and respectful language about donation by HCA scientists, including by herself.

“I think we had a lot of open conversation, a lot of open dialogue. I was definitely made to think about what words I use when I explain things, because again, I work in that kind of domain where it’s very emotive. When you try and explain it to somebody, it’s an incredibly emotive component of life, because we are talking about death. So for me, this has really improved how I convey information, but equally to listen to how people are interpreting what I’m saying to them.” (HCA member)

“There’s definitely more dialogue, not just within and around Cambridge (where a lot of the work on tissue/organ donation is going on), but UK wide. And from the HCA perspective, there’s more understanding of how terminology affects others. Scientists are now being much more respectful in their language, about organs, use of organs and tissue donation. In fact, I’d say there’d been a monumental shift in terms of language. It was probably happening anyway, but One Cell at a Time has pushed it into being something that’s more consciously attended to in meetings.” (HCA member)

Increased willingness and motivation to get involved in co-creating art/science engagement activities

HCA members talked about how One Cell At A Time had provided a unique opportunity to get involved, alongside artists and public engagement professionals, in co-creating art/science engagement activities. Experiencing this type of engagement practice first-hand was very inspiring for many HCA members, and helped to increase their willingness and motivation to continue to engage with publics through art/science processes.

“I think, we’ve all had the amazing opportunity to actually interact with such a diverse group of artists, which is very unusual, because most public engagement programmes are not as big as this, and that diversity was really eye opening, because they all came with very different approaches. And just finding out how the artists could actually extract or co-create with the public, focusing on what was actually important, what captured the imagination, what was effective, what was not known, and what was not really covered very well. And therefore, all of that information informing us in terms of the future direction of where we want to go, what we’ve been good at, and what we’ve not been so good at. So I think that’s something that my team and myself have learned.” (HCA member)

“Yeah, it made me more want to take part in public engagement. For me, it was definitely a really good sense of morale, because I didn’t realise that people outside of science would actually really be that interested, because it can seem very heavy, which I think puts people off being interested. But if you can communicate things in a simple way, then people do actually take an interest, which I’ve enjoyed.” (Q3 HCA member)

“And actually, a lot of the researchers were engaged and wanted to participate. And also equally the artists partners who were just equally, you know, interested and keen to work together. So there was actually a desire to work together on everyone's part.” (HCA member/ OCAAT team member)

Members of the OCAAT team also noticed that the strength and quality of the interactions between artists and HCA members inspired their commitment to public engagement through art/science approaches:

“I was worried that the interaction between us and the scientists would be more superficial. That we would just present ourselves as more of just an interruption to their daily business, and that we wouldn't really get that level of emotional engagement that we need, as artists, to be able to create an emotional expression of their scientific engagement. And that hasn't been the case, has it. We've had some really strong interactions with the scientists. I'd say that's the biggest thing, really, that the scientists are committing to the public engagement - or the ones that have been in contact, that we've worked with. Which is really valuable. (OCAAT team member)

4.2. Conceptual outcomes – increased knowledge and understanding

Data from Q2, Q3 and interviews with members of the OCAAT team suggested that HCA members had experienced conceptual outcomes in the following areas.

- Broader recognition of the part they each play to progress the work of the HCA:

“A better understanding of how different the research projects part of the HCA can be.” (Q2 HCA member)

“That being a software developer rather than a researcher or bioinformatician isn't a barrier to delivering this contact to schools.” (Q2 HCA member)

“I guess it's if people feel positive and happy about the research they do in the office, they're excited about it, I think it's really good for a sense of morale. For me, it was definitely a really good sense of morale, because I didn't realise that people outside of science would actually really be that interested. So yeah, because it can seem very heavy, which I think puts people off being interested. But if you can communicate things in a simple way, then people do actually take an interest, which I've enjoyed.” (Q3 HCA member)

- Greater understanding of the value of public perceptions and contributions to HCA research and how engagement with communities can improve research quality:

“The general shift to understanding what public engagement contribution can do for science, what it can do for your work specifically, as a scientist, is good to see as well. There's been a shift from ‘This is something that is not going to benefit me at all but is something I am giving my time to’, to (it) being that two-way street of communication and gaining information back the other way.” (OCAAT team member)

“I think we've created opportunities for HCA members to experience what it means to really understand and listen to people's opinions and reflections on what the HCA means to them.” (OCAAT team member)

“Because ultimately, everything we get requires consent. And every time someone consents, they need to know what they're consenting for. And so there's a bigger appreciation of that now that informed discussions.” (OCAAT team member)

“And I think, quite significantly, they are really thinking beyond that transactional, one way, knowledge transmission, protocol, that often is the way for science-led public engagement, and really thinking about that active dialogue, that can be facilitated from a range of different perspectives and in a range of different ways.” (OCAAT team member)

- Increased understanding about the value and effectiveness of art/science public engagement activities:

“Well, I think I was quite surprised. Or, yeah, I was quite impressed with how the art itself, because you imagine art is like someone painting a picture, for example, drawing or sketching, but I've never seen that type of art before. It was

graphics based. It looked amazing. I don't know how it was done technically. So yeah, I learned about different mediums for engagement, I guess.” (Q3 HCA member)

“I think it is a very effective way to communicate concepts which may otherwise be very challenging to communicate. I mean we're dealing with very, very complicated, very detailed bits of information sometimes, and it's having that different perspective of how people take in information. It's great to see the art being able to complement that, and really presenting it in a new light, that I wouldn't have thought of.” (OCAAT team member)

“Realising that there is a lot of creative similarity in research and in art!” (Q2 HCA member)

- Increased understanding about how art/science public engagement can be successful in reaching different public groups and communities.

“I think art can reach people that wouldn't that don't like or understand facts or text but would be interested if they were shown. It's difficult for me to explain. I think art can be an effective way of engaging people who are not necessarily, who think they're not interested in science or think science is too difficult for them. I think it can be effective at grabbing people's attention.” (Q3 HCA member)

“I think an art/science approach is incredibly effective, and it just offers another way of speaking to people. Science can be quite exclusionary, and has all its own terminologies, and the art sector can be like that too. So bringing those two together really forces both sides - and anyone in the middle - to think about communication and how you get people to engage. And I definitely think that's what this project has started to do.” (OCAAT team member)

- Increased understanding of what is involved in art/science public engagement

“I think I would definitely do something like One Cell at a Time again, I'll be more enthusiastic for it. Now, having done that. I just know what the process is like, and sort of understand how it also works, and also saw the sort of finished product that happened at the end, the bits and pieces that everyone had, and was put together so expertly in exhibition? And it's great to be able to be a part of something like that.” (Q3 HCA member)

4.3. Capacity-building outcomes – new technical, artistic and personal development skills

HCA members highlighted capacity-building outcomes in one key area: the development of new skills in planning and delivering art/science led public engagement. The following quotations show, however, that the focus of these new skills was primarily improved communication skills, rather than more specific art/science engagement skills developed personally by researchers. This reflects the organisation and delivery of One Cell At a Time engagement events, where artists and producers were the primary drivers for delivery, working in collaboration with researchers to plan, design and sometimes to co-deliver activities for public groups.

“Yeah, definitely. That really improved my communication skills, like the way I present stuff, the way I talk about my research to a really young public, I would say that definitely improved, because I had to prepare what I was going to say, and trying to say it in the easiest way possible. And also having the question that you never expect that really improved my communication skills.” (Q3 HCA member)

“I think for the HCA scientists, I think what came up is actually thinking about how to articulate and communicate their research through a different use of language.” (OCAAT team member)

“I think doing the video for children was useful to try and see how I can express myself.” (Q3 HCA member)

“I think I've learnt to summarise research in a way that is understandable by people who don't have a science degree. And to learn to work with people who aren't scientists, like observing how they work and working with them based on how they work rather than just giving them a list of facts.” (Q3 HCA member)

The inclusion of art and artists in the project was thought to have improved the communication of complex science and enhanced the development of accessible language and two-way conversations between scientists and publics:

“The key thing for me has been what a significant difference the use of artists made to how people engage with science. It's been revelatory. And a project like the Human Cell Atlas, which is life altering, is something that's really important. So it's been really significant to approach the science in a way that makes it understandable for the public.” (OCAAT team member)

“I do think it has been a very effective way of communicating things, allowing people to engage - because I feel like they can have that voice and have that understanding, feel a bit included. And I guess science can be quite exclusionary in the language that we have; it's sometimes its own little language that people just talk in acronyms and various other Latin words, and it can alienate a lot of people. Whereas the art part of it is really bringing the communities into that and making it more engaging.” (OCAAT team member)

“And also, what I've really particularly enjoyed with this one is how our focus groups both had the artists and the HCA scientists and community members working together, but what was amazing is that actually in the conversation it wasn't so clear split. So we had scientists who had personal beliefs, who could actually bring in their cultural perspective as well, and then some of our panellists actually were really knowledgeable in microbiology and could bring that as well. And this made for really rich, non-hierarchical conversations, and I think for me that's a big outcome.” (OCAAT team member)

4.4. Instrumental/behavioural outcomes – changes to behaviour, actions or practice

Evaluation data highlighted a number of areas where involvement in One Cell At A Time has already had an instrumental impact on the behaviour, actions or practice of HCA members.

In terms of Human Cell Atlas research, an anticipated outcome (see Annex D) was the ‘development of new research questions and areas for the HCA to tackle’. There was some very interesting initial evidence of this in the short term; though it is not clear whether these questions and insights will have an impact on HCA scientific inquiry in the longer-term. Bringing together artistic and scientific perspectives was also thought to facilitate new, and creative, ways of conceptualising scientific questions and research ideas as the following quotations suggest:

“In terms of combining art and science, I think this has been such a big reminder that there is a very, very fine line between the two. And on a platform where you mix the two, people come at the same science with a very different perspective, or a different pattern of thinking, you start to open doors in a very different way. And I found that to be very engaging for me, on a personal level. You're taking people who are trained in a very different kind of art form, or different capacity. And what they do is they see the same thing, but they see different things in it and ask different questions.” (HCA member)

“Art gives us this platform where we can discuss ideas and thoughts that would normally in a scientific field be held by the rules, by the physical laws. Whereas in art, you can remove those barriers and have those slightly more boundary pushing conversations because the art will pull your mindset into a slightly different perspective rather than, as a scientist you're bound a little bit by the physical laws and the regulations, whereas in art because it's perception it gives us a little bit more of a freedom space to toy with that idea.” (HCA member)

“I think probably the other thing for me is just seeing how people respond differently when there's art involved. It's just a different emotional response that brings down a barrier that's often difficult to bring down when you're talking about subjects that can be taboo, or overly emotive, there's something that allowed people to ease themselves into the conversation. And I think a lot of the artists have done that really well. And the calibre of the artists chosen has just meant you get the interest quite quickly from arts media as well. So there's lots of elements about it, I guess. The credibility of the scientists and the artists that already start the project off as being something that people are willing to let you talk to them about, which is really helpful.” (HCA member)

“I think the artists all had an innate capacity to hold that space, and to ask difficult questions. And really value what the researchers said, not just on a scientific level, but I think they were all very interested in the human aspect of the

science. And I think it'll benefit the publics, because I think that the participants that took part in their discussions and the events had direct access to these scientists, they had direct access to these artists, and sometimes over a long-term trajectory on a weekly basis in a regular way, sometimes in a one off event.” (OCAAT team member)

There was also evidence of other research-related instrumental outcomes, namely:

- More discussions within the HCA community about doing more public engagement and formalising the role of public engagement as part of the HCA research going forwards

“... and there's becoming a bit more momentum behind doing public engagement as a formal thing within HCA, which is something that I was just discussing with a few people this morning. I think just the fact that we're having those discussions highlights already that the communities within HCA are taking this a lot more seriously.” (OCAAT team member)

“People are considering it more - scientists wanted us to get patient involvement straight up front, so that we ask the public what they think of this, and then we can take that along to our ethics approval committee and say, ‘We want to do this work. Oh, and by the way, we've also talked to the public, who overwhelmingly said it was an amazing piece of work, and they wondered why we hadn't started doing it earlier.’ So they are now actively seeking to get this information from the publics; the dialogues which have been generated are really helpful. But it's also directly coming back to their research, meaning that they're more successful in terms of the ethics committee.” (OCAAT team member)

- Increased consideration of public engagement in research planning and grant applications by HCA members

“People are now including public engagement in their grant applications. There's a good legacy, but there's still work to be done in maintaining the momentum.” (OCAAT team member)

“HCA members are thinking about the values, opinions of communities and their research, to the point where they are thinking about that in their experimental planning. They are very, very ambitious these scientists, the projects they come out with are incredible, but we are seeing that extra layer now - during the planning – they talk about the scientific justification, they talk about the operational logistics, and then we'll talk about ‘How are we going to manage this? How's it going to appear from the outside? How are we going to show everyone why we're doing this work?’” (OCAAT team member)

- New public engagement activities developed by other research groups outside the HCA.

“One Cell At a Time has inspired them. And they're now doing much broader things. For instance, the Tree of Life Project has now taken on a public engagement member as part of their team. And this is very clearly due to the inspiration from seeing the public engagement around the Human Cell Atlas and what we've achieved through One Cell at a Time.” (OCAAT team member)

There was also evidence of continued and increased engagement with the OCAAT programme by HCA members, over the lifetime of the project and beyond. HCA members described how they:

- Intended to stay in touch with the OCAAT team and artists

“Get in contact with some of the artists about my research.” (Q2 HCA member)

“Stay in touch.” (Q2 HCA member)

“Continue to be in touch with HCA outreach.” (Q2 HCA member)

“Happy to stay engaged with the project.” (Q2 HCA member)

“Formal discussion with one of participants.” (Q2 HCA member)

“Link more scientist to artists.” (Q2 HCA member)

- Intended to be involved in other OCAAT events and activities

"Sign up for ArtSci II." (Q2 HCA member)

"I might sign up for the HCA PE lessons, although I do not work on the HCA project directly myself." (Q2 HCA member)

"HCA Card Game playtesting?" (Q2 HCA member)

- Shared information with other colleagues leading to further increased engagement with the programme

"Pass on the information to my team." (Q2 HCA member)

"And it started off with a few key people, so there were package leads really taking that drive and taking it forward, and then it percolated out into the other HCA communities that they're part of, who are now coming in a lot more. So I think that is a really big success, because one of the hardest things is just getting input from the scientists, full-stop. And to see that we're getting that is incredible." (OCAAT team member)

"I think it's comes from top down. And I've noticed that quite a lot as I've been going through this project - that if the principal investigator goes, 'this is a really amazing project. It's really cool. And I'm going to champion and I'm going to push it' - it ripples out into their team and all their team want to get involved. If the PI is disengaged, then they just don't. And I think what's happened is, as the PIs meet with each other and talk about these things, and really start talking peer to peer about how they found that useful, it then sort of spreads and they get the idea, and then they want to be involved. So I think it's informal discussions between all the scientists that has really helped it move forward." (OCAAT team member)

One other area of instrumental outcomes for HCA members was in terms of their own public engagement practice. For some, the experience of One Cell At A Time had helped them to reflect on how they approached public engagement and to consider making small changes and adjustments to existing practice:

"Re-assess my assumptions; look at how we can explore conversations with a bit more clarity." (Q2 HCA member)

"Think more about how to sum up my work to young people or non-scientists." (Q2 HCA member)

"Never considered post packs or the more light-hearted way of looking at tissue donation for research, good idea." (Q2 HCA member)

For others, being involved in OCAAT offered a ready-made platform for engagement, and had inspired them to seek out new opportunities to engage with different communities:

"Yeah, it made me more want to take part in public engagement. There's a public engagement team at work. So yeah, it makes me want to continue with public engagement, not as a full-time job because I have a job that I enjoy, but where I can just spend some time. I'm interested in the education side. So maybe helping out with school visits on campus, which they do. Or general public visits to campus, that sort of thing." (Q3 HCA member)

"So, yes, I think there is improved dialogue in general. The fact that there's more getting put out there about the research that wouldn't have been otherwise. It gives the scientists a platform to talk about these issues." (OCAAT team member)

"For me, I think the amount of engagement that the scientists have given willingly to this project has astounded me. Because they are very, very busy people, they all have many different grant applications, papers, various other things to write every single day, and yet they're willing to take time out of that to talk to the public, and it's really great to see." (OCAAT team member)

"Deliver content to schools." (Q2 HCA member)

"Join in and learn how to participate in a school's meeting." (Q2 HCA member)

“Summer science 2021 - Royal Society exhibition.” (Q2 HCA member)

“The work of the city teams was more accessible, it made more sense to a broader audience. It didn't assume any knowledge in terms of science or in terms of art. And it was in accessible locations that either local people could just drop into, or it made very clear sense when you were watching it online. There were multiple ways in which you could connect with it. With low or high engagement, so that you could invest as much or as little time as you wanted in all those artists teams.” (OCAAT team member)

Finally, in terms of instrumental outcomes, HCA member involvement in One Cell At A Time also provided opportunities for more formal recognition and reward of public engagement activities, particularly for early career researchers. For instance

“And I have to say that I did put it on my CV and my public engagement for my appraisal and stuff like that.” (Q3 HCA member)

“I think this is a great opportunity to showcase junior researchers, you know, they've had a lot of opportunities to actually participate. And to provide that opportunity and experience at a very early stage in people's careers, and the reach around the country, that's a very important outcome, because there's a network of people who've all had the opportunity to participate.” (HCA member)

4.5. Connectivity outcomes – new connections and relationships

For HCA members, being involved in One Cell At A Time brought them into contact with a range of new people. This enabled new connections and relationships to be developed, and in some cases maintained with external organisations, groups and communities, including artists, producers, public communities, teachers and school/college students. OCAAT offered HCA members a menu of ready-made new connections – the complexity and effort involved in finding and maintaining connections with delivery partners and publics was handled by the OCCAT project team; but led to connectivity outcomes for HCA members.

“I think what we've been able to do over the last 18 months is to develop really strong relationships with core organisations and individuals, from across the piece, so from, obviously, the partner institutions, where, as I say, many of those HCA members involved are actively involved in the HCA research and have developed confidence, and have developed relationships, and have had significant experiences, presenting their work in a range of different ways to very different kinds of people.” (OCAAT team member)

“There's definitely more engagement now. People are more enthusiastic to do more. There's more recognition of the importance of public engagement. And there have been tremendous efforts put into finding communities to engage with, although a social media presence would have helped.” (OCAAT team member)

One Cell AT A Time also facilitated collaborations and connections between HCA members and across research groups, so offering internal networking opportunities to share ideas and learning, provide support for public engagement and to recognise and celebrate the work of the programme as a whole.

“There are more opportunities for collaboration. And that's important for the scientists. And, again, it's a tangent that they wouldn't have considered, getting funding for this type of activity, and it's something that they've become more aware of. Maybe that's part of the legacy aspect of it. But the fact that it's opening up collaborations that would never have been considered before is, I think, quite an important short-term outcome.” (OCAAT team member)

“... that growing culture of HCA members, engaging with each other outside of the lab context and talking about the science and the impact and the importance of the science in more public settings. And I thought that could be seen in every city. And with all the institutions that had partnered on that Wellcome bid, and I don't think there was any institution that didn't engage. So that was really effective.” (OCAAT team member)

"We were talking about having a symposium that would showcase all the learnings, anything that's come out of this, and the fact that people are talking about this and really want it to happen, at a very high level - we're talking executive office level - that is a monumental shift in thinking that I've observed." (OCAAT team member)

4.6. Affective outcomes – sensory, emotional and experiential responses

Questionnaire and interview data captured some of the affective outcomes for HCA members involved in One Cell At A Time, showing their sensory, emotional and experiential responses to being involved in the art/science co-creation and engagement process:

A sense of fun and enjoyment

"I just enjoyed the workshops, hearing what people thought about the research and their perspectives on it. I would just say that it's been really interesting to work on something that's quite novel. And I enjoyed it. I feel lucky that I've been able to do it as part of my job." (Q3 HCA member)

"So, first, I just wanted to be involved in the explanation of what we do to the public, I think that is the important reason why I joined. And what I enjoyed the most was probably the activity with the schools, where the child could elaborate a challenge with cards. That was a really fun time. So yeah, I think that this is what I enjoyed the most: school interaction. I think any kind of experience like that's for sure beneficial for the people you're giving to, so the public, and also fun for you." (Q3 HCA member)

"I guess the most fun thing, I think was going to the exhibit and looking around on the website, clicking through it, seeing something that I had said, up there on the website, which is perhaps slightly childish, but also extremely cool to just see that translation from the interview to the finished product." (Q3 HCA member)

Interested and reflective

"Insights, reflections." (Q2 HCA member)

"How interesting it was to step back from my work and look at it from a different angle." (Q2 HCA member)

"Made me feel intrigued. Have never really thought about how I feel about new discoveries etc." (Q2 HCA member)

"Feeling all my cells - reflecting on my self - is very wholesome." (Q2 HCA member)

"We are only one small grain in the universe - but we are alive and unique and amazing." (Q2 HCA member)

"I thought it was actually a very interesting thing to do. Glad I did it." (Q3 HCA member)

"Interesting to reflect on donation vs gift." (Q2 HCA member)

"I guess from a personal standpoint, it's always really interesting to be able to talk about what I do, and that's a lot of fun, being able to talk through the process with someone who doesn't know a lot about it, or someone who has a different perspective. That's always very, very interesting." (Q3 HCA member)

Curious and inspired - a wish to discuss and explore further

"For me quantum physic and philosophy give a more comprehensive thought atlas for our interconnectivity. But the discussion was well lead and got scientists out of their 'zone' to think BIG and wild!" (Q2 HCA member)

"Engagement in a different type of world where art and research can collaborate." (Q2 HCA member)

"Enthused that there are other outlets for our work." (Q2 HCA member)

"I would have liked to have more time to explore concepts that we started discussing and better appreciate the connection with ensuing art-making." (Q2 HCA member)

4.7. Summary of outcomes for HCA members

Evaluation data indicates that the following short-term outcomes were achieved for HCA members as a result of their involvement in the One Cell At A Time programme as participants, co-facilitators, and presenters:

Attitudinal outcomes

- Increased willingness to view public engagement as a two-way opportunity for dialogue and to seek out multiple perspectives on HCA research
- Increased willingness to consider using different methods for engaging communities and more confidence and motivation to do so
- More willing and enthusiastic to engage and communicate with a range of different public groups and communities about HCA research
- Increased respect for the value of organ and tissue donation for research
- The use of more thoughtful and respectful language about donation
- Increased willingness and motivation to get involved in co-creating art/science engagement activities.

Conceptual outcomes

- Broader recognition of the part all HCA members play to progress the work of the HCA
- Greater understanding of the value of public contributions to HCA research and how engagement with communities can improve research quality
- Increased understanding about the value of art/science led public engagement activities and how these can be successfully delivered to different public groups.

Capacity-building outcomes

- Development of new communication skills in planning and delivering art/science led public engagement.

Instrumental/behavioural outcomes

- More discussions within the HCA community about doing more public engagement and formalising the role of public engagement as part of the HCA research going forwards
- Increased consideration of public engagement in research planning and grant applications by HCA members
- New public engagement activities developed by other research groups outside the HCA
- Continued and increased engagement with the OCAAT programme
- Changes to public engagement practice.

Connectivity outcomes

- New connections and relationships developed and maintained with external organisations, groups and communities, including artists, producers, public communities, teachers and school/college students
- New collaborations and connections between HCA members and across research groups
- New opportunities for internal networking to share ideas and learning, provide support for public engagement and to recognise and celebrate the work of the OCAAT programme as a whole.

Affective outcomes

- A sense of fun and enjoyment
- Interested and reflective
- Curious and inspired - a wish to discuss and explore further.

5. Successes and challenges: learning from the OCAAT programme

This chapter describes key successes in the delivery of the OCAAT Programme, highlights some of the challenges faced by the programme and draws out learning for future public engagement initiatives within the HCA consortium and potentially more widely.

5.1. Successes

Interviews with OCAAT team members (including the core team, work package leads, and city-based and other creative teams) highlighted a range of factors that had helped to facilitate the successful delivery of the programme. These are summarised below.

Strategic and financial commitment

Strategic commitment to the OCAAT programme was seen as a significant enabler and was clear from the start: the Wellcome-funded engagement programme was headed up by one of the HCA Co-Chairs, and three senior HCA members were embedded as work package leads with key oversight for different workstreams. The presence of both HCA Co-Chairs at the culmination of the OCAAT programme – the launch of the online One Cell At A Time exhibition – was also seen as an important moment of strategic support for the programme

“It was really, really interesting to have at the launch event, the two Co-Chairs topping and tailing the event. I thought that was such a moment of advocacy and validation for the project. I think very special to have both of them in the same space at the same time.” (OCAAT team member)

Financial commitment was evident in the provision for infrastructure support for the OCAAT programme (central coordination and curation role, with scientific, communications and IT support) alongside resources for engagement activity in the programme budget. This was seen as a significant factor in the successful delivery of the programme:

“And for all of this really, you need to have funding. And one thing that has come out of it is that if you invest properly then you get amazing things out of it, which we have done with this scale of investment. But to get individuals to do art science collaboration on a shoestring, and in a very limited scope is very difficult. I mean, we’ve been lucky, we’ve had that diverse network of individuals, that dedicated coordinator, but not many programmes have that. So it’s always very difficult. So you can leverage many more things, and synergize and collaborate, have a central portal and things like that. You need to recognise that, you know, if you invest, well, you get a good return.” (OCAAT team member)

Senior-level champions

Visible commitment to the OCAAT programme from senior HCA members as work package leads was seen as key to the level of engagement from HCA members more widely. Leading by example, these senior scientists had championed participation amongst their colleagues:

“For me, the amount of engagement that the scientists have given willingly to this project has astounded me. Because they are very, very busy people, they all have many different grant applications, papers, various other things to write every single day, and yet they’re willing to take time out of that to talk to the public, and it’s really great to see. And it started off with a few key people, so there were work package leads really taking that drive and taking it forward, and then it percolated out into the other HCA communities that they’re part of, who are now coming in a lot more. So I think that is a really big success, because one of the hardest things - and you can ask our public engagement team at Sanger - is just getting input from the scientists, full-stop. And to see that we’re getting that is incredible.” (OCAAT team member)

Work package leads also championed the use of accessible language, facilitating the communication of scientific content to public participants:

“I think from our side, the people who were chosen as the work package leads are so great at being able to talk to you in a way that doesn't baffle you entirely. And that was really what we were trying to get out of them in every interaction we had with them, because we're translating it into mainstream media or outreach content for just the general public. So that was really helpful, because, from a comms perspective, had that not happened, it would have been very, very difficult to create a story that resonated with just your average person.” (OCAAT team member)

Central coordination and curation

The central coordination and curation role was seen as critical in developing and managing an extensive programme of activities, and creating an environment in which relationships between researchers, artists and publics could flourish. HCA member involvement was facilitated from the outset, providing the structure and opportunities for HCA members to experience meaningful public engagement:

“I was really, really keen to engage HCA members and take them on that journey with me. So, everything from writing artistic briefs to shortlisting to interviews to really thinking and talking through the different strands of programming, and all of those things, we engaged with HCA members throughout. And I think we've created opportunities for HCA members to experience what it means to really understand and listen to people's opinions and reflections on what the HCA means to them.” (OCAAT team member)

Work package leads and OCAAT core team members commented on the highly successful curation and management of the OCAAT project, especially within the context of adapting to the constraints of the pandemic:

“Delivering a face-to-face project virtually in a tight time frame, managing to pull together a deluge of work, which has got widespread praise from a lot of different people, is just incredible. And I think it just goes to highlight that this structure that (the curator) built was very successful. And it was able to flex and adjust to a lot of changes and uncertainty. And I do think it is a very good model for how this thing could happen again, in the future.” (OCAAT team member)

“I thought it was exceptional. I mean, I thought this was like pure dedication, amazing ambition from (the curator) and to have to adapt in a way that no one has ever adapted before.” (OCAAT team member)

The support from the HCA and the WSI team was also viewed as key to the project's success:

“And also, you know, a massive thanks to people from the HCA executive office in Sanger. There is no way that we could have pulled off the IT support that was required to host this. And I mean, this is a massive scale IT infrastructure, which had to be put together. And there was constant communication - I don't think anything was ever done without any of us really knowing what was happening.” (OCAAT team member)

“The fact that it was coordinated by Sanger, who provide a lot of the IT support, which was not something that we originally anticipated and budgeted for, but made it happen that that is really important. The technical support that had to be brought in to adapt to the pandemic environment.” (OCAAT team member)

City-based and creative teams also noted the importance of the support provided by the core team to facilitate their contact with HCA members:

“I think they have been phenomenal in setting up those meetings. Because every time we've sort of pinged them and said, Can we meet with x? And then they've contacted them really quickly, and managed to organise it, which is really good. And I think without that, it would have slowed things down a bit. But those meetings were established really quickly.” (OCAAT team member)

“But I think what's been really wonderful is bringing together events of us as just artist groups, and then elements like the sci-art salons, that were for the whole international HCA network, and then smaller events that were just for meeting the scientists. So there's been a huge amount of energy and time and care, very, very tightly curated and thought through network and community fostering between the commissioned artist groups, between the other

public engagement elements. So informing us and keeping us in the loop - from the poetry jam and schools, to the games, and - I mean it's amazing, in terms of the breadth of it." (OCAAT team member)

Work package leads and OCAAT core team members highlighted the major achievement of delivering a complex public engagement programme in the challenging context of a pandemic:

"I think the key success was the fact that we made it happen. I think that the programme has done remarkably, in spite of the situations that was thrown at it, I think that's something that needs to not be forgotten. We conducted a public engagement event in a time where the public was not allowed to engage. It was great, because it meant we can meet with communities without having to leave quite an extensive carbon footprint. So for me, I'm still in awe of how we've spun the whole system to use the development of technology in that time to make this work." (OCAAT team member)

"It's probably the biggest public engagement programme in the UK, if not the world, where it's been coordinated at that scale, and to show that that can be done, and that can be done very effectively across many geographical sites, that it can be done in unprecedented times, primarily using virtual modes to communicate and also exhibit and that has been phenomenally successful." (OCAAT team member)

"And it was a very big, very complex task that we had to adapt every step of the way. I think, not one of our events happened the way we wanted it to, or the way it was planned in the grant application. But we did it. We have the events. We had the game. We had the normality. We have the public engagement, we had the discussion around different things." (OCAAT team member)

"It's been a logistical and operational nightmare to get all the moving pieces to align. But we've managed to do that, in a pandemic. And I think the fact that everyone has come together and gone that extra mile to make it happen is a success in itself, from my point of view." (OCAAT team member)

OCAAT online engagement model

Pandemic restrictions required the development of a new online engagement model. Despite the challenges of this new model (see 5.2 below), the online approach succeeded in achieving many of the anticipated outcomes for OCAAT (see chapters 3 and 4), and the ways of working (with small groups over extended periods of time) had resulted in a deeper level of engagement than would have been possible in larger activities:

"I think just having the time to do that has meant a lot. Given such a big amount of time, not just to reflect, but to have these meetings with different members of the public and with researchers again and again, and build on them, rather than feeling like, this is the one conversation you have. And actually making these meaningful relationships with both public and researchers has really meant a lot." (OCAAT team member)

"Even though we didn't have as many people as maybe we wanted - the feedback that came back was really deep and really thoughtful and really intimate. And each bit of the process has worked really well. And the stuff that we've got back has shown that people have really appreciated it, and people have really felt like these tools and these kits that they've got have spoken to them, in ways. So we haven't got the huge numbers of public engaging in the project, but we have got really deep engagement, and really - and for me that's always key." (OCAAT team member)

"So instead of breadth, we've got depth. As a researcher, obviously, that's absolutely key. Because if you don't have the depth, then you have no idea whether anyone has actually felt anything, or anything's actually shifted in people when they've actually been part of this. Which for me, as a designer, is really key. What has it meant for people? And the fact that people are beginning to have these really much more detailed conversations about donation, that's been incredible. An outcome that I wouldn't really have imagined." (OCAAT team member)

"But yeah, I think it creates something really interesting having to work like that. And they would never have come to those open workshops, those people. There's no way they would have engaged in that way. Because it took three months probably to settle into those conversations with them to shift from kind of initial stuff to actually really start talking. And it took time. And it feels like the findings from that are just starting to emerge." (OCAAT team member)

"I'm really interested in that longitudinal work with smaller groups of people - you can travel further if you put your energy with into smaller group for a longer time, than if you disperse that energy over more people over a shorter space of time." (OCAAT team member)

The engagement model was also thought to have encouraged public participants and HCA members to continue working with the ideas raised by the workshops:

“But the key successes that I feel like we’ve had have just been in the reactions and the conversations that we’ve had with the researchers and the public. They have just been, I think, some very personal responses, you know, of people saying that they will take some aspect of it outside and into their lives or their daily practices. And, similarly, with one of the researchers, he was saying it had already influenced the way he was thinking about his work.” (OCAAT team member)

The art/science approach to public engagement

The combination of art and science in the OCAAT project was thought to be particularly successful in providing new and diverse opportunities for engaging with science:

“I think we really catalysed the potential of artistic and creative thinking, in order to open up new ways for people to really understand what the HCA means.” (OCAAT team member)

“I think it’s absolutely amazing, actually, how that interface innovates, new thinking, new approaches, new interactions, new communications, impacting both artists, public, and the researchers, getting the public to inform the direction of the research. It’s basically like a fertile area for things to grow. So what we’ve built essentially is a fertile ground. For new perspective, new ideas, new communications, new synergies.” (OCAAT team member)

“What I particularly enjoyed is the kind of almost transformation of the concepts behind the research, the relevance of the research the findings into alternative formats, where people can begin to experience and engage using many more senses than normally. I mean, it’s usually visual text or visual image. But here, all the other senses come into play, and also making it more emotive and immersive, which you don’t quite get in the standard, conventional science communication.” (OCAAT team member)

The artistic approach to engagement with science was also seen to have successfully facilitated new entry points for publics who may not respond to traditional forms of science communication:

“I thought it was very, very effective. It brings in a fresh perspective on the work we’re doing, it brings in a wider audience who would not have otherwise engaged and it makes it more fun. And even if somebody looks at it and goes, I don’t really understand what this is showing, but I’m going to read up on it now - that is still an achievement. So, I think it’s been hugely successful. From my point of view. I’ve never come across an art/sci approach before this project. And it’s something that, again, if we would do this type of project, again, it would have to have art/science in it.” (OCAAT team member)

“I hope it was effective because I think art can reach people that don’t like or understand facts or text but would be interested if they were shown. I think art can be an effective way of engaging people who think they’re not interested in science or think science is too difficult for them. I think it can be effective at grabbing people’s attention.” (HCA member)

“I think what I’ve really enjoyed is, is being able to connect the art sector with the science and the science sector in such an equitable way. And I think the work that emerged from the programme really reflects the equitable relationship that both parties had within that space. And it opened up a space, I think, a really interesting and authentic space for different kinds of people to come in and experience the science in a really interesting spectrum of different kinds of ways. And I think that’s what I really enjoyed the most really, just seeing what I’d hoped would happen, emerge.” (OCAAT team member)

“It did what I hoped it would do, it would provide a breadth of different pathways into the heart of the science and would broaden out the ways of knowing and understanding what that science was about, and the impact of that science on individual lives, as well as that macro impact transformational impact on healthcare and our understanding of biology.” (OCAAT team member)

OCAAT team members also highlighted the benefits of the art/science approach for the quality of engagement process:

- Provided a safe place to have critical conversations:

"I think the arts are a good place to take safer risks, in a way, than we can in science. Science is under so much scrutiny at the moment as well, they have to be extra cautious and extra careful about the message that goes out about any projects and any research that are being undertaken. Whereas in the arts we can be more playful, and we can take more risks. And that leads to a safer place to have critical discussion as well, where nobody has to be right or wrong, necessarily." (OCAAT team member)

"For me it's about opening out, unfolding that space for critical conversation and imaginings. So imaginative, speculative, uncertain, unfixed space for potential - and encouraging people to be part of it and to work into it. So some of the challenges of science-based communication, I guess, are about complexity, which is obviously the first thing, so things are very complex, and you need certain levels of education or knowledge or language, even, to understand those core concepts. But then there's also the kind of perceived fixedness of the scientific discipline, and this idea of knowledge production and truth production, and those kinds of statics, whereby I think the arts and humanities and design - these kinds of discourses - can actually pull some of those things apart and build conversational themes and topics which allow gathering spaces for public to explore their own perceptions of those things. And build relationships and build trust and build scrutiny and criticality." (OCAAT team member)

- **Facilitated depth and quality of engagement:**

"From what I've understood from working with (the artists) is that the main purpose is that emotional experience; that experience that happens on a different level, where you might not remember the exact name of that cell and how it works, but you will remember the ethical conversations that you had around it, and you'll remember the emotional experience that you had during the workshop, which will last much longer. And I find that so important, and extremely valuable. So I think for me that's where the value lies: the type of experience and the quality of experience, rather than just getting people to remember a spreadsheet." (OCAAT team member)

"I think it's the scientists understanding what it can do. I don't think the public have a problem with that. I think they understand that art offers something and a way in, a way of provoking thought and generating knowledge." (OCAAT team member)

"I really think and hope that this project will be a kind of milestone project in art/science collaborations. We have worked a lot previously in commissions, but by galleries or museums, or places where it's like the artistic is the starting point, rather than the other way around. And the fact that such a big scientific project is welcoming this public-facing, art/science work I think is extremely valuable, and I hope it will inspire a lot of trans-disciplinary collaborations like this in the future. And I think it will, because I think we have shown - and I think with the exhibition, that hopefully will have a far reach - that a lot of people across scientific and artistic and other disciplines will see the value of this experience, the value of it." (OCAAT team member)

Working with external partners to extend the reach and depth of engagement

A key success of the programme was working in partnership with a range of external partners to extend the reach and depth of engagement with public participants. The OCAAT core team worked together with specialist partners to help widen access and reach both diverse and specific public communities. These partners included the city-team-based producers who were able to facilitate local community access and engagement through their existing networks and by working to establish new networks and contacts; and via two national-level arts organisations: Little Inventors; and the Young Poet's Network hosted by the Poetry Society. Both these latter organisations had extensive and well-established networks of engaged participants with existing commitment and enthusiasm to work on new online challenges through the host organisations' websites. In these ways, the project was able to reach out more widely through partners' existing connections and networks, leading to greater engagement with HCA science:

"We've got a lot of feedback from people saying they've enjoyed trying to write outside their comfort zone and try and rethinking the sort of binary between arts and sciences. So those are all really positive things. And the feedback that we got from the entrants was really positive about the Human Cell Atlas, and they wanted to learn more, and they wanted to use biology again in their writing." (OCAAT team member)

Online mechanisms to further extend reach and depth of engagement

The project was also able to extend the reach and depth of engagement by ensuring that activities and resources were available online, via the Human Cell Atlas YouTube channel, and via the One Cell At A Time website and online exhibition. This enabled significant additional online reach after activities and events had taken place and has created ongoing opportunities for legacy engagement post-programme.

"I think that's the beauty of what the web portal access allow them to do, and many are amazed by what has been achieved. I have had loads of positive comments. I think this will be really useful to showcase for future funding, but a lot of it depends on the funder. (OCAAT team member)

Once we made the decision earlier this year that we were going to do an online exhibition, I'd always conceived that it was going to be a legacy outcome, basically, that could be augmented and extended and hopefully become a platform that will bring diverse public engagement activities together under one umbrella and presented as an ongoing documentation of how people have engaged with HCA over time, and maybe in time, become an archive of different kinds of projects and programmes and discussions and talks." (OCAAT team member)

"It is really good that the website has been maintained. And I imagine we're going to hopefully keep the microsite for the schools maintained for the next couple of years. And so that's really significant. They're brilliant outcomes that will have legacy." (OCAAT team member)

"The thing that I'm really excited about this project is the level of engagement that we've had. There's one scientist that we've engaged with really closely. And so their presence in the work is really strong, and their response to the work is really strong. And so I'm hoping that that means that the thing that's been created is a really good expression of the science, that will make it quite valuable as a public engagement artefact." (OCAAT team member)

5.2. Challenges

In our interviews with them, OCAAT team members (including the core team, work package leads, city-based and other creative teams) all commented on some of the challenges for the OCAAT programme. These are summarised below:

Covid-19 pandemic restrictions

The arrival of a global pandemic imposed inevitable challenges and restrictions on the OCAAT programme. The necessary transfer to online-only delivery generated a significant amount of extra work:

"The challenge of, of trying to completely shift our planning from one mode to another (in-person to online), which was significant." (OCAAT team member)

"But I imagine that's been the same for everyone. At the end of December, we were all booked in to do a physical workshop in the new year. So our mindset was it's going to be physical, you know. And the suddenly, obviously, lockdown hit, and we were like, we've got to make it downloadable. And so it has to be so much more robust, because they're going to have to download it on all different platforms." (OCAAT team member)

The lack of in-person interaction was thought to make participant recruitment more challenging:

"I would just reiterate how hard it was to engage people in this context. Really, really hard. And how do you build trust if you can't go and knock on a door? So that was very new to me. Normally you'd actually go to the neighbourhood and do it a little bit differently. So that was very challenging, to put that group together. Although it eventually did shape up really nicely, but it was hard." (OCAAT team member)

Online delivery also affected programme reach, in particular creating barriers for people without access to a computer or the internet, potentially limiting the programme's ability to reach diverse populations:

"I think it's important to note the context that we had to work in. In the last 18 months, the pandemic was really challenging as a space to think about bringing different people together, particularly vulnerable people, and also with maybe more diverse groups, or groups that maybe weren't necessarily accessing online opportunities as much as maybe we would have liked them to, essentially. And so I think we were on the whole really successful in achieving the aims that we laid out with the Wellcome Trust application. But I also do recognise that the context has an impact on maybe some of the aspirations that we had." (OCAAT team member)

"The huge challenges are basically balancing I think, a virtual reach versus face-to-face interactions. Virtual you have a global reach, but are you selectively not reaching to the population that may not have a computer or internet or the ability to navigate the app, and then there's a lot of it focuses on the visuals, because of the virtual format, rather than any other formats. Are you biasing in a way?" (OCAAT team member)

The reach of the 'How to Build a Human' card game challenge for schools was thought to be significantly affected by the pandemic. School closures, the transfer to online learning, limited resources available to support extra-curricular activities in this context, and variable access to computers at home meant that participation was lower than had been expected, and participants were more likely to come from (well-resourced) fee-paying schools:

"And I think the aim was to reach as many schools as possible, and in particular, non-fee-paying schools or schools in less well-off areas. And I think there was a particular push towards schools in the north and the northeast, particularly because those schools are often less engaged in the kind of extracurricular activities, or they get less encouragement with those or less opportunities for that. And the number of schools was much more limited than we envisaged. I think the difficulty because everything was obviously accentuated even more in the pandemic, like reaching those schools, where there's maybe more pupils, less teachers, and everything only made that harder, which was a shame." (OCAAT team member)

"I would have really liked to have been more successful in engaging those maybe more underrepresented schools, or those schools from maybe more underrepresented areas with maybe a more diverse range of students. And I think it was basically capacity that stopped that from happening. And because of that, I think the true potential of that project wasn't reached, I think we hit all the boxes, we gave people a fantastic time, we generated a really fantastic output. But from my side of things, I do think that the lockdown, and the capacity of teachers during that really challenging time just meant that we didn't get the reach that I would have hoped for." (OCAAT team member)

"What was different to our usual challenges was more just the demographic that entered. So there were about 9 schools that entered and about half of those were private schools. It's different because you don't usually get so many private schools. Yeah, because obviously, the winner, particularly I know, their teacher was highly supportive, but you need a parent or a teacher, of course, in that role, you know, really driving this, and they did help that. And also the technical requirements to share, and we need a laptop - all the usual stuff that was a big barrier. Some people just didn't have that availability - one laptop in the family, and they couldn't share. And it's a big, big problem." (OCAAT team member)

The lack of in-person activities with schools had affected the development of and participation in the card game challenge for schools:

"The biggest thing was testing, because we had planned to kind of go to the schools to do a bit more hands-on work. And we could have probably gone at least once but that just didn't become a possibility. So we had to test online and it was a bit cumbersome, really, in the way to do it and I couldn't give it to them for them to test in their own way. And that was annoying. We got around it, you know, but that was a kind of a problem with it. I think we just did the best we could." (OCAAT team member)

"I think what you might find is a lot of schools do run game clubs in their schools, but that was obviously massively affected, you know, a lot of schools are only just getting back to even thinking about game clubs. And it would have been a perfect vehicle to kind of bolt onto a Game Club. And I think in the normal times that might be easier." (OCAAT team member)

The challenges in supporting students from less well-resourced schools was thought to have impacted the final entries in many cases:

"It's a bit disheartening in a way that when we saw the entries, they were very diverse. And we weren't looking at any filter in terms of where they came from, we were just looking at the ideas. And then we looked at the ideas we all liked, and then worked out where they come from. And there was such a disparity between the public schools and state schools. And it was quite shocking. And it's not that the children are any more talented, but it is just the time and the availability of the teaching. It was quite striking. When you see a project like this, and it's quite tangible. And I think under normal circumstances, that disparity I would hope would not be there as much. You always can see a bit of course, but it was just so polar." (OCAAT team member)

The online nature of the OCAAT programme was also thought to have limited communication between artists and researchers:

"And we've had to really feel our way into a very different infrastructure, and in a distributed fashion, largely in the online space. And that again, offered opportunities, but also limitations. People weren't able to meet researchers face to face, they weren't able to have serendipitous moments, or conversations in a lab, where they sidled up to a researcher exploring something and asking questions, they didn't necessarily get to touch on the atmosphere." (OCAAT team member)

"I have been fascinated by the science of it. And the projects of the HCA. And I would have loved that extra time with scientists to actually get into that, because I think that's been the missing thing. I think, if you're looking at all the projects as well, I think the missing thing is has been that time. Because I think we would have potentially found more human stories in there." (OCAAT team member)

"I think one of the big concerns with everything when it went online, because we're very used to working collaboratively with scientists, where we go to their space and we experience them in their space, and shadow them, and spend some time immersed in that world. And I was really thinking I can't see how this is going to work, just Zooming in and chatting to people through Zoom." (OCAAT team member)

"In similar programmes that we've had, that have been more physically based, in terms of the artists and the curators and the people involved in the project have met up in a location, and there's been a stronger interaction between the different artists and the different groups working on the project. And that's something that hasn't been so strong with this project. I think there could have been a little bit more of that, in terms of the wider group, where artists can understand how the other projects are going with the other artists, and how their work or working process relates to the other artists. And then we would have had a much stronger understanding of that curatorial direction, really." (OCAAT team member)

"I would have liked a little more at the end. So we did a lot to put it all together. We've now developed all of this, we've had those conversations, we've got the art show out. This is for me, is really where the conversations could get picked up again, either having a night of just sitting on Discord, or on a computer and having conversations. If we were having the gallery opening, for example, to show and display, you'd have those conversations there. And I think, while we've done so much leading up to it to adapt what we need, this is the one bit that I'm a bit sad that we didn't do." (OCAAT team member)

...and limited communication with public participants:

"I think the most challenging challenge for me was to do it online. But that was not really because of the programme, but because of the pandemic. But yeah, I think the engagement with the children was really difficult. Yes. Because you don't see them, and you don't talk to them as you would in person. So that was a big challenge for me." (HCA member)

"It's just such a shame that some of it has been so massively hampered by the pandemic and not being able to get people together, because I think that really would have enhanced - or brought it to life a lot more." (OCAAT team member)

Working with HCA

OCAAT team members reported that the lack of permission to develop and implement a social media strategy had further affected the reach of the programme, particularly in terms of the online elements:

“Not being able to have access to social media accounts during a pandemic when everything is virtual, has been, I think, one of the biggest challenges. Had we had access to the social media accounts, we would probably be able to reach more of the communities we were not able to. I think this is definitely a learning we need to take into the next time we do this type of project. If it involves HCA, we need some sort of agreement up front that there will be a social media presence in one way or another. Even if it needs sign-off in any which way. Because having that presence is really important.” (OCAAT team member)

“I think probably the idea of having those permanent public engagement channels, yes, undoubtedly would have really transformed how many people this project has reached. But I also think for HCA it would just be an incredible resource - they could cultivate an audience there that is currently missing from what they do, that would be really valuable, all over the country and all over the world, by just thinking differently about how you're presenting information about the work that happens. Because I think this project has proven, despite all the challenges, that there is a public interest in it. And it's just about finding different ways to activate that interest at the beginning of a project.” (OCAAT team member)

“I think it really was the communications that proved the biggest sticking point. And there were limitations to our access to social media channels, for example, and during a time, when really, that was the primary outlet for distribution of information. At times, it was really challenging. Having no access to a channel of communication, that can really speak to people in a way that public engagement really needs to speak to people was really difficult.” (OCAAT team member)

“I would just really like from the beginning to have really clear processes for how things actually get delivered into the world. But I kind of think that has happened now throughout the process organically, most of that stuff's there, and it would just be using it from the beginning of a project rather than developing it as you're delivering a project.” (OCAAT team member)

The HCA's lengthy sign-off process for communications had also been challenging:

“And it was difficult, I think, at the beginning of the relationship with the HCA comms team, because it just felt like we were at counter purposes all the time. And that was quite difficult for us - it felt like we couldn't do anything, marketing-wise. But that has definitely improved as the project's gone on.” (OCAAT team member)

“The bureaucracy stops us being agile - bureaucracy of HCA meant that any piece of text that went out had to go through quite a lengthy approval process. And it doesn't work when you're trying to be snappy and trying to be quick and engage people in real time. If we were doing this, again, we couldn't do that. It just wouldn't work. And again, appreciating this has grown organically, and teams have changed as we've moved through. And there's been a better awareness of public engagement, but there's still a long way to go there. So it either needs to be that there is less control from top down about these types of messages, or there just needs to be a very clear slick process of how things get signed off. Because it's not clear internally with HCA.” (OCAAT team member)

Size and complexity of project

OCAAT team members noted challenges related to the large and complex nature of the programme, including:

- The administrative burden:

“And from a personal point of view, as I mentioned, operationally, logistically this has been a very big challenge. There are a huge number of contracts involved, a huge number of invoices involved, it's a very demanding admin burden for anyone that takes us on. And I think it's, again, just how the project was structured, and moving forward we may want to think about having people embedded within the institutes involved as well, to try and lessen this.” (OCAAT team member)

- Project timescale too short:

“And I think the timeline of a year is really tight - unless you're an artist or designer who's already worked in this area, just to get your head into that science space, just to get your head into some of the complexities and themes, to build the audience, to build the communities, to get the recruitment, to get ethics, if you're working in a university. So just to get all of those things in place actually takes a really large amount of time.” (OCAAT team member)

“Well, as a pilot a year is good, but I think I would recommend, if they want to continue it, continue it ASAP so that we don't lose those connections with people. But I have read somewhere that if you want to do community engagement, ideally it takes three years, not just one. And in a way it kind of shows it, because now they're really, really warm. They've experienced it and they know how great it is, and I'm sure they would help us even more with the recruitment now, of participants.” (OCAAT team member)

- Available resources not sufficient for scale of project:

“I think we're probably all delivering slightly above and beyond in terms of time input beyond the budget. And that's something that I am trying to manage very carefully, these final stages. That's not a critique of the project management, but it's almost like, in a sense, what everyone and the whole project is trying to do, within actually, whilst a generous, also fairly limited budget per artist group, it's sort of like, OK, we just also need to put parameters on it and deliver that and concede that I think there's something about that space of collaboration and the enormity of the scientific element of it, that you go, Wow, there are so many ways this could go. And it does become really exciting, but it also can become - it's the universe. It's so enormous. So it is about going, Actually, how do we rein this in and look after ourselves in the middle of it all? So, yeah, I completely understand the potential, but actually the reality of it.” (OCAAT team member)

“So (the curator) has been brilliant; she's contracted for two days a week and works much more than she should. We need, if we're going to do this again, we need a small village to make it happen, basically. Everyone has pulled out the stops, and it's been an incredible amount of work for everyone involved in it, at the Sanger side, within the One Cell at a Time team and at the other institutes. And so I think that is a big learning, that we need to be considerate of that moving forward, if we were going to do something at this scale again, we're probably looking at a bigger budget, looking at more head count, looking at - this has been incredible value for money, but now that we've learnt how it actually works, it's unlikely to be able to be done again at the same budget.” (OCAAT team member)

- Difficulty in communicating the full breadth and depth of the programme:

“It's too big, there's too much in it for us to tell all the stories that could be told, just in terms of the available time that we had, and then all of the structure around things being signed off. I think we only really scratched the surface of telling the story of what it was and all the different artists involved. We could have done press campaigns for six or seven months on each artist because there's so much to dig out and how they work with scientists. There's so much in there that I think it was incredibly brilliant and rich and ambitious. But it was too almost too unwieldy for us to get everything out there into the public domain.” (OCAAT team member)

5.3. Successes and challenges: summary of learning

Evaluation participants' reflections on the successes and challenges of the One Cell At A Time programme indicate key learning points for future public engagement initiatives within the HCA consortium and potentially more widely.

Findings show the following to have been significant determinants in the successful delivery of public engagement:

- Sustained strategic and financial commitment, including high level endorsement and advocacy, and investing in support for infrastructure as well as for programming activities
- Senior champions, demonstrating visible commitment to the public engagement initiative and encouraging engagement from researchers more widely

- Central coordination and curation, managing and providing direction for the programme of activities, and creating an environment in which relationships between researchers and publics can flourish
- Focus on depth of engagement, building relationships with public participants over time
- Use of an art/science approach to public engagement, providing new and diverse opportunities for engaging with science, and facilitating new entry points for publics who may not respond to traditional forms of science communication
- Partnerships with a range of external partners, extending the reach and depth of engagement with public participants
- Development of online resources, enabling significant additional online reach after activities and events have taken place, and creating ongoing opportunities for legacy engagement post-programme.

Many of the challenges identified in 5.2 above relate to the specific constraints of undertaking public engagement during a global pandemic, and the resulting move to online delivery. Whilst it is to be hoped that these constraints do not continue indefinitely, any future use of online delivery for public engagement will need to put in place strategies to address the identified barriers of this approach that include:

- Reduced reach in under-represented areas and groups due to limited internet and computer access, and lack of necessary support for virtual engagement
- Limited opportunities for participant recruitment in the absence of in-person approaches
- Limited communication between researchers, facilitators, and publics in the absence of face-to-face interactions.

Other challenges raised by evaluation participants related to the size and complexity of the project, and ways of working with the HCA. These point to the need for future public engagement initiatives to:

- Ensure that sufficient resources are available to match the scale and ambition of the project
- Extend timescales to allow relationships with publics and deeper engagement to develop
- Build in sufficient time for relevant sign-off processes from the start, so that engagement activity can proceed as planned
- Consider the merits of creating a social media presence for public engagement initiatives and develop policies and processes to provide a framework for such activity.

6. Conclusions: the longer-term impact of One Cell At A Time

This concluding chapter presents a summary of the outputs, reach and short-term outcomes achieved by One Cell At A Time and examines the extent to which the overall aim and longer-term objectives have been addressed. We also draw out some conclusions and recommendations to inform the development of future similar public engagement work.

6.1. Summary of outputs, reach and short-term outcomes of One Cell At A Time

Outputs and reach

The One Cell At A Time team developed, co-created and delivered an ambitious and multi-faceted programme of public engagement with the Human Cell Atlas, including events and activities aimed at both public groups and individuals and HCA members. Over the lifetime of the programme:

- 41 different events and activities (including multiple workshops, talks, discussions, sharing events, lab events, films, publications, online challenges, the online exhibition³⁰ and the OCAAT website³¹) were delivered across 110 sessions³², leading to:
 - 1,067+ instances of engagement with public participants
 - 128+ instances of engagement with HCA members.
- The total reach of the programme (from July 2020 to end of December 2021) was at least 7,047 in person and online engagements with public participants and HCA members. This includes post-event and legacy engagement via recordings on the HCA YouTube channel and via the OCAAT website and online exhibition.

Short-term outcomes

There were significant short-term outcomes for participants as a result of their engagement with OCAAT activities, including for public participants (diverse and specific public groups and communities, children and young people, and teachers); and for HCA members (who took part in the programme as participants, co-facilitators, and presenters). The evaluation found robust evidence of changes to people's attitudes, skills, knowledge, behaviour, connections and emotional responses in relation to the following core outcome areas.

HCA research

With reference to the theory of change (Annex A), public communities that engaged with the HCA were indeed enabled to have a voice and to realise the value of their contributions to HCA research. In addition, evidence showed that HCA members and contributors recognised the

³⁰ <https://www.onecellatime.org/exhibits/>

³¹ <https://www.onecellatime.org/>

³² This included where one event or activity was delivered more than once

part they each played to progress the work of the HCA and had greater understanding of the value of public perceptions and contributions to HCA research and how engagement with communities can improve research quality.

The evaluation found that participants experienced outcomes in terms of:

- Positive changes in attitudes (in terms of value and trust) towards scientific research, the Human Cell Atlas and science more generally
- Increased knowledge about HCA research and how it is conducted
- Increased understanding of how they can contribute to HCA research
- Increased awareness of the value of their potential contributions to HCA research
- Increased awareness and understanding of how HCA research affects them now and in the future
- Increased understanding of human cells and how the body works
- Greater awareness of the scale and global reach of HCA research
- Increased knowledge of scientific terminology and broadened understanding of science more generally
- Having new conversations with family members and peers about the impact and potential of research and the HCA project
- Feeling empowered to find out more about the HCA
- Feeling empowered to conduct their own research in areas of interest that HCA science had inspired
- Feeling empowered to explore more connections between art and HCA science
- Being inspired to find out more about human cells and biology
- Feeling excited by the activity and the work of the Human Cell Atlas
- Feeling curious and having a wish to further discuss and explore ideas and issues raised through OCAAT activities
- Feeling connected, inclusive, listened to, and valued – empowered by having a voice in a wider project
- Broader recognition of the part they each play to progress the work of the HCA (HCA members)
- Greater understanding of the value of public perceptions and contributions to HCA research and how engagement with communities can improve research quality (HCA members).

Tissue and organ donation for research

The project's theory of change (Annex A) suggested that people involved in engagement activities would be enabled to share experiences, questions and concerns (including around use of language, GDPR, consent and open access data); and to have more conversations with their friends and family around research and tissue donation. Evidence from the evaluation showed that (with the exception of information sharing about GDPR) all of these anticipated outcomes - and more - were achieved. Public participants experienced outcomes in terms of:

- Positive change in attitudes and new perspectives in relation to organ and tissue donation and its use in HCA/biomedical research
- Increased respect for the value of tissue donation for HCA/biomedical research
- More willingness to discuss wishes around research and tissue donation with families and friends
- Increased knowledge and understanding of tissue donation for research, particularly within the context of the Human Cell Atlas
- Increased understanding around consent, data sharing and ethical issues in relation to tissue donation for HCA research
- More conversations with friends and family around research and tissue/organ donation
- Plans to clarify wishes relating to organ and tissue donation generally, and for research purposes and to do more fact-finding in this area to better inform decision-making.

For HCA members, outcomes were experienced in the following areas:

- Increased respect for the value of organ and tissue donation for research
- The use of more thoughtful and respectful language about donation.

Scientific (STEM) and medicine career pathways and opportunities

As outlined in the theory of change (Annex A), the project anticipated that the young people and communities involved in the activities would be more aware of the varied career opportunities and pathways provided through knowledge of STEM subjects and medicine. For public participants, the evaluation did indeed find positive evidence of:

- Increased awareness and understanding of the varied STEM and medicine career opportunities and pathways available
- Greater interest in science and medicine subjects and career pathways; and in creative and artistic career pathways.

Art/science led public engagement approaches, methods and resources

The project's pre-existing theory of change did not include any expected short-term outcomes specifically in relation to art/science public engagement. The OCAAT team co-created an additional outcome in this area which suggested that the project would trial art/science-

focused public engagement approaches, methods and resources which recognise, explore and articulate the value of both scientific and artistic outputs and contributions. This was achieved by the programme, in addition to a range of other outcomes relevant to the core area. The evaluation found significant evidence that people who engaged with One Cell At A Time experienced art/science-related outcomes in terms of:

- A positive impact on attitudes towards art/science led approaches, methods and resources
- Recognising the value of bringing art and science together to discuss complex issues
- Increased understanding of how art and science intersect to explore new meanings, practices and patterns
- Expanded understanding of the nature of different forms of art, dance and creativity
- New ideas about sources of inspiration for creativity
- Opportunities to be creative
- New skills creating artistic forms, artefacts and practices in response to HCA research, including skills to present scientific ideas in a visual way, through creative writing or through use of poetry
- New technical skills and practices in response to HCA research, including skills in how to design a card game
- New personal development skills, including increased understanding of team roles
- Development and delivery of new learning activities in response to HCA research
- Continued engagement with the project and/or similar activities in the future
- Finding out more about other artists and creatives working with the HCA and more widely
- Finding out more about art/science as an engagement approach
- Continued creative and artistic work, including continuing work started during OCAAT activities and events in the following areas: poetry and creative writing; cells, patterns, movement and dance; game creation and use of data.
- New connections developed with a variety of colleagues across disciplines who are interested in creative collaboration
- New forms of collective creativity developed
- Connections developed between artists and scientists
- Plans to stay in touch with some of other participants.
- Having a sense of fun and enjoyment

- Feeling happy, positive, relaxed, calm, reassured
- Feeling interested and informed
- Feeling emotionally and intellectually moved and engaged
- Feeling proud, grateful, fulfilled – with a sense of having achieved something.

For HCA members, outcomes in this area were numerous and included:

- Increased willingness to view public engagement as a two-way opportunity for dialogue and to seek out multiple perspectives on HCA research
- Increased willingness to consider using different methods for engaging communities and more confidence and motivation to do so
- More willing and enthusiastic to engage and communicate with a range of different public groups and communities about HCA research
- Increased willingness and motivation to get involved in co-creating art/science engagement activities
- Increased understanding about the value of art/science led public engagement activities and how these can be successfully delivered to different public groups
- Development of new communication skills in planning and delivering art/science led public engagement
- More discussions within the HCA community about doing more public engagement and formalising the role of public engagement as part of the HCA research going forwards
- Increased consideration of public engagement in research planning and grant applications by HCA members
- New public engagement activities developed by other research groups outside the HCA
- Continued and increased engagement with the OCAAT programme
- Changes to public engagement practice
- New connections and relationships developed and maintained with external organisations, groups and communities, including artists, producers, public communities, teachers and school/college students
- New collaborations and connections between HCA members and across research groups
- New opportunities for internal networking to share ideas and learning, provide support for public engagement and to recognise and celebrate the work of the OCAAT programme as a whole.

- A sense of fun and enjoyment
- Interested and reflective
- Curious and inspired - a wish to discuss and explore further.

6.2. Progress towards the overall aim and longer-term objectives

The overall aim of One Cell At A Time was:

- To bring about a cultural shift towards enhanced and sustained engagement with the Human Cell Atlas across research and public communities.

The OCAAT team hoped to achieve this aim through working towards the following longer-term, broader objectives, which were anticipated beyond the lifetime of the public engagement programme:

- Generate dialogue and transparency between HCA UK members and communities, that addresses questions and concerns around research and tissue donation, including use of language, GDPR and consent
- Build a culture within the HCA where UK members seek out and value the opinions and experiences of patients and communities who donate to research studies
- Co-develop a common language that enables HCA UK members to effectively communicate their work to different communities
- Normalise conversations within families and communities around tissue donation for research
- Create a foundation from which future public engagement activities across the whole HCA consortium can be built.

This evaluation has brought together evidence of the short-term outcomes achieved for public participants and HCA members within the lifetime of the project. It was not part of our brief to seek evidence for implementation of the broader objectives in the longer-term. One would not expect to see evidence of a cultural shift towards sustained and embedded public engagement with HCA research after a pilot project of just 18 months. However, it is possible, at this juncture, to explore where there is some evidence of **progress towards** these longer-term objectives and to highlight the key features of culture change that this evidence represents.

Improved dialogue and transparency about HCA research

The sheer range and diversity of attitudinal and conceptual outcomes experienced by public participants provides strong evidence of improved dialogue and transparency about HCA research. Many people described newly acquired knowledge of the purpose, need, value and scale of the Human Cell Atlas and increased understanding of how HCA research might affect them now, and in the future. Participants expressed their increased knowledge of how HCA research is conducted and showed increased understanding of how they themselves may be able to contribute to the Human Cell Atlas.

Indeed, evaluation data provided evidence of positive changes in attitudes, increased knowledge and understanding and more respect towards organ and tissue donation and its use in biomedical research, particularly within the context of the Human Cell Atlas. Public participants' engagement with One Cell At A Time had also enabled them to share and explore their attitudes and understanding around some of the consent, data sharing and ethical issues involved in tissue and organ donation, in ways that they had not previously considered.

A culture within the HCA where UK members seek out and value the opinions and experiences of patients and communities who donate to research studies

Evaluation data from HCA members showed evidence of increased respect for the value of organ and tissue donation for research, which came about through open dialogue between HCA members and public communities. One /OCAAT team member suggested that, significantly, the project had facilitated the use of more thoughtful and respectful language about donation by HCA scientists.

There was also increased willingness from HCA members to view public engagement as a two-way opportunity to seek multiple perspectives, and to have a dialogue with a range of public communities. The evaluation showed that HCA members were increasingly willing to consider using different methods for engaging communities and felt more confident and motivated to do so. There was also evidence from HCA members of greater understanding of the value of public contributions to HCA research and how engagement with communities can improve research quality. There was some initial evidence, in the short-term, that bringing together artistic and scientific perspectives had facilitated new, and creative, ways of conceptualising scientific questions and research ideas. It would be interesting to continue to map this outcome in the longer-term and to explore the on-going impact, if any, of art/science public engagement on the nature and content of HCA scientific inquiry.

More effective and appropriate communication for engaging with different communities about HCA research

A key objective of the OCAAT programme was to trial art/science-focussed approaches for engaging with different communities about HCA research. Evaluation responses indicated that these approaches had most definitely delivered effective and appropriate communication about the Human Cell Atlas enabling both publics and HCA members to recognise, explore and articulate the value of both scientific and artistic outputs and contributions.

Both public participants and HCA members described their engagement with OCAAT events as 'fun' and 'creative'. They both talked about being 'inspired' and 'interested', and public participants said they felt 'happy', 'involved', 'engaged', 'informed', and 'connected'. Evaluation responses from public participants suggested that 93% agreed that OCAAT activities had helped them to understand the value of bringing art and science together to discuss complex issues and had helped them to explore new meanings, practices and patterns. For public participants responding to the evaluation, 88% were inspired by OCAAT activities and events to reflect on new ideas; and 78% said that they learnt new skills to present scientific ideas in a visual way, or through creative writing and poetry.

In addition, evaluation evidence from HCA members indicated they had increased their understanding about the value of art/science led public engagement activities and how these can be successfully delivered to different public groups. Many HCA members described how they had developed new communication skills in planning and delivering art/science led public engagement and the inclusion of art and artists in the project was thought to have improved the communication of complex science and enhanced the development of accessible language and two-way conversations between scientists and publics

Evidence of more regular and open conversations within families and communities around tissue donation for research

Just under half (41%) of public participants responding to the evaluation said they were planning to have more conversations with friends and family around research and tissue/organ donation (19% had already done this irrespective of their involvement with the project). Responses suggested that sharing information about their wishes, and finding out about the wishes of others, were key areas for these conversations. People also talked about making plans to clarify wishes relating to organ and tissue donation generally and for research purposes, and plans to do more fact-finding in this area to better inform their decision-making. In addition, 58% of public respondents said they were definitely planning to start conversations with family members and peers about the impact of the event or activity they had attended and/or HCA research.

New foundations created for future public engagement across the whole HCA consortium

Instrumental outcomes for public participants members indicated a strong desire to ‘stay in touch’ with One Cell At A Time and the Human Cell Atlas more widely. People had made new connections and were keen to maintain these. Publics were inspired to continue and develop the artistic and creative work started during OCAAT activities and events and felt empowered to find out more about the HCA, human cells and biology. Many people talked about their intentions to conduct their own research in areas of interest that HCA science had inspired. Evaluation data from publics showed that 84% were interested in being involved in this sort of engagement activity again – clear evidence of a strong interest from a newly established network of potential participants for ongoing engagement with the HCA.

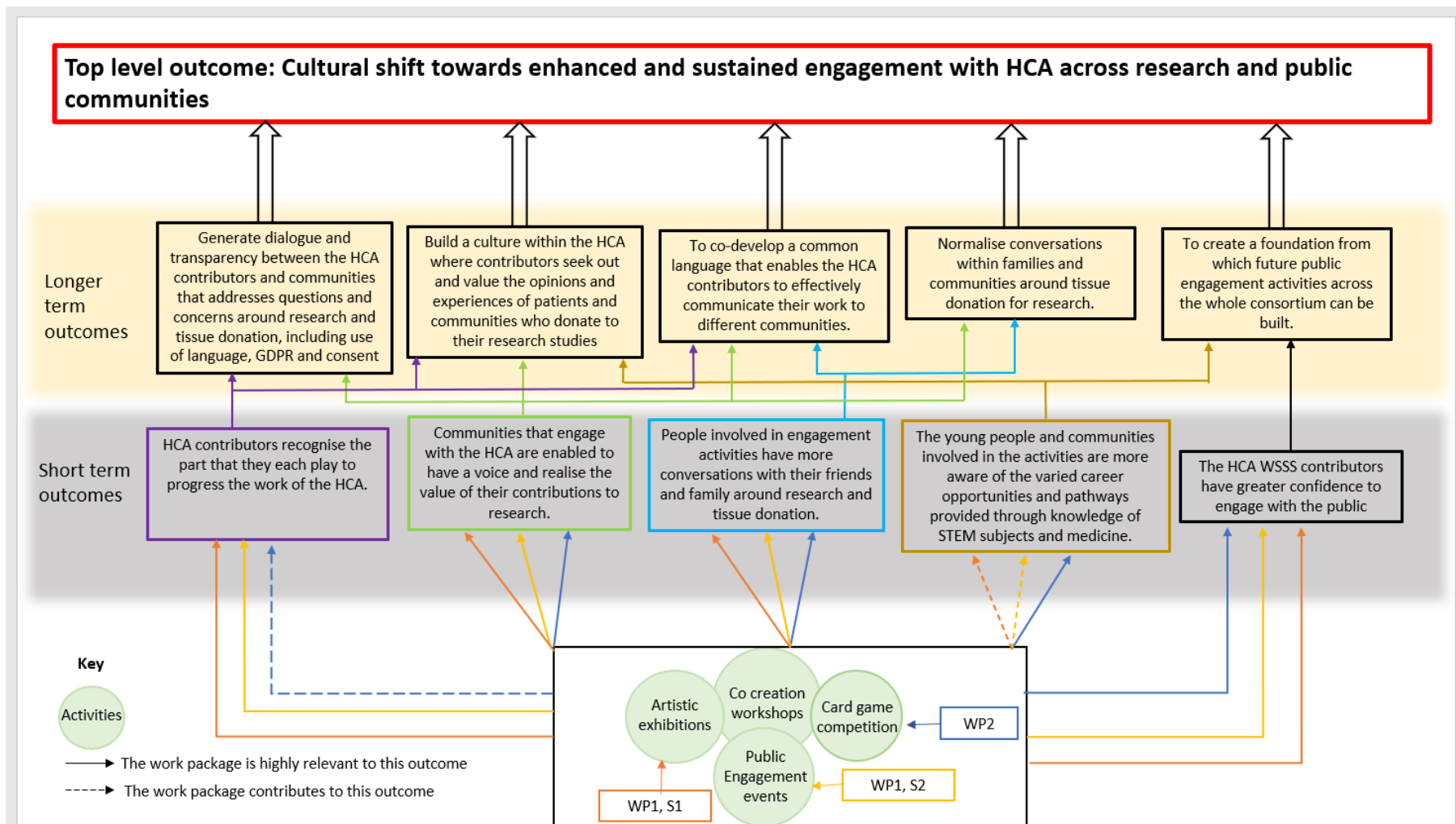
For HCA members, there was evidence of continued and increased engagement with the OCAAT programme over its lifetime and beyond, so creating a supportive ‘community of practice’ for art/science public engagement. HCA members described how they intended to stay in touch with the OCAAT team and artists; to be involved in other OCAAT events and activities; and had shared information with other colleagues leading to further increased engagement with the programme. Being involved in OCAAT offered a ready-made platform for engagement and had inspired them to seek out new opportunities to engage with different communities. The programme had also provided opportunities for more formal recognition and reward of public engagement activities, particularly for early career researchers.

6.3. Concluding comments

The successful implementation and positive outcomes achieved by One Cell At A Time have provided a model for on-going public engagement within the UK HCA and potentially across the

wider Human Cell Atlas consortium. Time is now of the essence in order to build on these initial foundations and maintain the momentum for sustaining and embedding an effective art/science approach to engagement with the HCA across research and public communities.

Annex A: One Cell At A Time - theory of change devised by the project team



Annex B: One Cell At A Time evaluation - logic model

Aim of the One Cell At A Time public engagement project: To achieve a cultural shift towards enhanced and sustained engagement with HCA across research and public communities			
Inputs	Activities and outputs	Short term outcomes (end-of-programme)	Progress towards longer term goals (post-programme)
<ul style="list-style-type: none"> Wellcome Research Enrichment: Public Engagement funding of £348,810 over 18 months (July 2020 – Dec 2021) Host institutions: Wellcome Sanger Institute (WSI), European Molecular Biology Institute-European Bioinformatics institute (EMBL-EBI); Kings College University of London (KCL); University of Newcastle; University of Cambridge; University of Oxford PI: Sarah Teichmann WSI (Co-Chair of the HCA) Work package leads: <ul style="list-style-type: none"> Muzlifah Haniffa, Uni of Newcastle (WP1, strand 1) Krishnaa Mahbubani, Cambridge Biorepository for Translational Medicine. (WP1, strand 2) Anna Wilbrey-Clark WSI, EMBL-EBI (WP2) 	<p>Work Package 1: Public Engagement</p> <ul style="list-style-type: none"> WP1 strand 1a: Covid-19 Response & HCA³⁷ Member Engagement (July 2020 - Nov 2021) Covid-19 Response: University of Sunderland Animated Video - animated resource for young people (KS3) about how HCA scientists are helping the global fight against COVID-19 virus³⁸. ArtSci Salons x 4 – discussions between artists and scientists each focussed on a different theme ArtSci Exchange Events x 6 - sharing events across the whole HCA to foster new connections between OCAAT activity and HCA UK members: <ul style="list-style-type: none"> To issue a direct call to action for HCA members to engage with project delivery in various ways. To share learning from the OCAAT team throughout the duration of delivery. 	<p>Work Package 1: Public Engagement</p> <ul style="list-style-type: none"> Changes to attitudes, skills, knowledge, behaviour, connections and responses³⁹ of <u>HCA members</u> including: <ul style="list-style-type: none"> Actively seeking multiple perspectives from communities to improve their work and how they communicate with different groups Greater confidence to engage with the public Recognition of the part they each play to progress the work of the HCA Increased respect for the value of donation for research New ways of thinking, new modes of seeing and new contexts for doing are developed between diverse communities, researchers and contributors Changes in HCA-related attitudes, skills, knowledge, behaviour, connections and responses of <u>target public participants engaged</u>⁴⁰ including: 	<ul style="list-style-type: none"> Improved dialogue and transparency about HCA research - Dialogue and transparency are generated between HCA members and communities, that address questions and concerns around research and tissue donation, including use of language, GDPR and consent Improved participation in HCA research - A culture is built within the HCA where contributing members seek out and value the opinions and experience of patients and communities who donate to research studies More effective communication about HCA research - A common language that enables HCA researchers and contributors to effectively communicate their work to different communities is co-developed

³⁷ Purple text indicates OCAAT project elements not included in the evaluation work brief

³⁸ <https://www.humancellatlas.org/wellcome-engagement/>

³⁹ These outcome categories draw on (a) the Arts Council Generic Learning Outcomes for individuals engaged with the arts and culture sector; and (b) a framework commissioned by the ESRC to understand the potential outcomes of social science research - <https://esrc.ukri.org/files/research/research-and-impact-evaluation/research-impact-on-practice/>

⁴⁰ Target audiences/participants included: those previously not engaged with research or the HCA; BAME and migrant communities; specific patient groups affected by conditions investigated in the WSSS grant; existing and potential organ donors; education cohorts whose learning experience could be influenced by the research

<ul style="list-style-type: none"> • Management/Curation: Paul Gibson (WSI) and Suzy O'Hara (freelance/Uni of Sunderland) • Delivery: <ul style="list-style-type: none"> - 4 Artists/Creatives: NCL: Stacey Pitsillides & Holly Standing, Uni of Northumbria; LDN: Amanda Baum & Rose Leahy, Baum Leahy; CAM: Anna MacDonald, MMU; OX: Vicky Isley & Paul Smith, Boredom Research - 4 Regional Engagement Producers: NCL: Dominic Smith; LDN: Justine Boussard, RCA; CAM: Matt Burman & Hilary Cox Condran, Cambridge Junction; OX: Kieran Cox, Miranda Lawrence and Cathrin Poppensieker, Fusion Arts - Maker Lab facilitator and Zines creator: Dominic Smith - Social media/PR/marketing specialist: Crystallised - 30+ HCA researchers from the 6 host institutions • External partners: <ul style="list-style-type: none"> - Jana Eliasova, HCA medical illustrator; Nick Lewis, Lecturer in Illustration, Animation and Games Art, University of Sunderland (WP1a COVID response animation for KS3) - Esther Teichmann, RCA and Chris Stewart, University of the Arts; with workshops facilitator/researcher Jenny Bangham (Wellcome Fellow, University of Cambridge), writer Boris Jardine, composer Deirdre Gribben and production Studio Hato (WP1b artist film) - Midwives and sonographers (WP1 artist film) 	<p>WP1 strand 1b, 1c and strand 2 (Oct 2020-Nov 2021)</p> <p><u>Exploring what it means to be normal?</u></p> <ul style="list-style-type: none"> • City team-delivered artist commissions to co-develop artistic interpretations and responses that explore 'what is it to be normal?' • Embodying Normality (Newcastle) • Sensing Normality (London) • Performing Normality (Cambridge) • Speculative Normality (Oxford) • City team-delivered artist-led workshops (Feb-June 2021) to co-create artworks exploring the above themes. • Artist production and delivery of artwork for exhibition based on workshop outputs/outcomes (June-October 2021) • Online exhibition of artworks and linked live events (Oct-Nov 2021) and performances, created and delivered by the four city-based teams of artists and producers • One Cell At a Time website – including the online exhibition and other resources and artworks produced during the project. <p><u>Exploring what influences people's value and trust in research involving tissue donation and open access data</u></p> <ul style="list-style-type: none"> • Maker Jam (June 2021) - hackathon-style online workshops and events to inspire new ways of 'thinking through making', stimulating discussion around organ/tissue donation and open access data; including public 'lab-style' events to showcase artworks and create dynamic dialogue. <p><u>Zines</u></p> <ul style="list-style-type: none"> • 8 Artist-created Zines (Oct 2020-Oct 2021 to track, share and record project progress in each city (Dominic Smith) 	<ul style="list-style-type: none"> - Increased awareness and understanding of how they can contribute to research, and how research affects them now and in the future - Increased knowledge about how research is conducted and how consent and data sharing works - Feeling empowered by having a voice in research that affects them, and by contributing towards effective and appropriate language used in the research - Increased awareness of the value of their contributions to research - Increased understanding of how the body works and how lifestyle and environment can affect health - Increased respect for the value of donation for research - Positive change in attitudes around tissue donation and its use in research - More conversations with friends and family around research and tissue donation - More willing to discuss wishes around research and tissue donation with families and friends - Increased awareness and understanding of the varied career opportunities and pathways available through knowledge of STEM subjects and medicine - New ways of thinking, new modes of seeing and new contexts for doing are developed between diverse communities, researchers and contributors 	<ul style="list-style-type: none"> • Improved awareness and understanding of donation for research - Conversations around tissue donation for research are normalised within families and communities • Public engagement legacy for the HCA - An art/science-led public engagement programme is developed which recognises, explores and articulates the value of both scientific and artistic outputs and contributions; and creates a foundation from which future public engagement activities across the whole HCA consortium can be built.
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<p>- Little Inventors³³, Dominic Wilcox, Ellie Birkhead, Phoebe Martin; Richard Heayes, Heayes Design Toy and Game Consultancy³⁴, Unity Schools Partnership (WP2 strand 1)</p> <p>- Newcastle Centre for Literary Arts, University of Newcastle³⁵(WP2 strand 2)</p> <p>- Poetry Society - Young Poets' Network³⁶ (WP2 strand 2)</p>	<p>WP1: strand 1c: RCA Commission (artist film) (October 2020-August 2021), includes:</p> <ul style="list-style-type: none"> • Community engagement and workshops with midwives, antenatal professionals (e.g. sonographers) pregnant women and HCA researchers to develop thread/script for the film • Scientist engagement workshops with composer, HCA researchers, other scientists, Wellcome Collection staff, and publics to develop script/score 		
	<p><u>Work Package 2: Engagement with Young People</u></p> <p>WP2 strand 1: Schools Challenge: How to build a human (Oct 2020–July 2021)</p> <ul style="list-style-type: none"> • Work with school students across the UK to encourage them to engage with the cutting-edge nature of the Human Cell Atlas's work and experience how science is applied in the real world while also developing their creativity and problem-solving skills. • Card Game Competition and Production - working with Little Inventors, secondary schools and game development company to explore HCA science around How to Build a Human - includes an online competition for KS3 students to design a card game linked to work of the HCA • Little Inventors phase (Oct 2020–Feb 2021): <ul style="list-style-type: none"> - Challenge resource development and prep with Unity Schools Partnership (Oct-Dec 2020) - Challenge delivery, card game ideation and selection of winning card game design (Nov-Feb 2021). Target reach: 9 schools; 900 students; 36 competition entries 	<p><u>Work Package 2: Engagement with Young People</u></p> <ul style="list-style-type: none"> • Changes to PE- attitudes, skills, knowledge, behaviour, connections and responses of <u>HCA members</u> including: <ul style="list-style-type: none"> - Greater confidence to engage with young people - More knowledge about how to discuss the contribution of STEM subjects to career opportunities and overall knowledge about health and disease - New ways of thinking, new modes of seeing and new contexts for doing are developed between young people, researchers and contributors • Changes in HCA science and research-related attitudes, skills, knowledge, behaviour, connections and responses of <u>schools participants engaged</u>, including: <ul style="list-style-type: none"> - Increased awareness and understanding of the varied career opportunities and pathways available through knowledge of STEM subjects and medicine 	

³³ <https://www.littleinventors.org/makers/>

³⁴ <https://www.playlenz.com/heayes-design-home>

³⁵ <https://www.ncl.ac.uk/ncla/>

³⁶ <https://ypn.poetrysociety.org.uk/>

	<ul style="list-style-type: none"> • Haeyes Design phase (March-July 2021): design, testing, production and print of card game <p>WP2 strand 2: Poetry Challenge (Oct 2020–Jan 2021)</p> <ul style="list-style-type: none"> • NCLA at Newcastle University worked with Young Poets’ Network (Poetry Society) to run a Poetry Challenge inspired by the HCA • The Challenge was open to young people all over the world via the Poetry Society’s website • NCLA conducted a schools workshop during the challenge to encourage entries • Four winners were chosen by NCLA and external judge and each winner received mentoring with an established poet-artist 	<ul style="list-style-type: none"> - Students feel engaged and excited by the work of the HCA and proud to have participated in the competition - Students are empowered to start conversations with family members and peers about the impact and potential of research and the HCA project - Students and their families have an increased understanding of how the body works and how lifestyle and environment can affect health - New ways of thinking, new modes of seeing and new contexts for doing are developed between young people, researchers and contributors 	
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Annex C: One Cell At A Time evaluation – evaluation plan

Evaluation phase	Data needs and initial indicators	Proposed methods for data collection
<p>Inception and set-up (Sept - Oct 2020)</p> <p>To understand and map the purpose, inputs and planned activities of the OCAAT project</p>	<ul style="list-style-type: none"> Inputs - Information about the background/context of the OCAAT project, delivery partners and the programme of activities 	<ul style="list-style-type: none"> Inception/scoping calls with OCAAT team, work package leads and the seven delivery teams (four artist/producer city-based partnerships; RCA; Schools Challenge; Poetry Challenge) Desk-based work/email communication to follow up key information/data Documentary review and analysis of initial proposals, partner commissioning documents and any other documentary evidence as advised/of relevance at this stage (including all documents on the shared Google Drive)
<p>Data collection 1: pre-and post-activity evaluation with participants</p> <p>(Oct 2020 – Nov 2021)</p> <p>To quantify, describe and map the outputs and outcomes of regional, national and online engagement activities for publics, children/young people and HCA members</p>	<ul style="list-style-type: none"> Activities - details of activities including HCA members involved, duration, location, purpose, aim, method of engagement, delivery partners, target participants (publics and schools) Outputs – reach and demographics of actual participants engaged Outcomes – evidence about the changes to attitudes, skills, knowledge, behaviour, connections and responses of participants engaged (publics, children/young people, HCA members) 	<p>Activity and output data:</p> <ul style="list-style-type: none"> Shared Google sheet for delivery partners to report key data before and after each activity <p>Outcome data:</p> <ul style="list-style-type: none"> In collaboration with each delivery team, we devised a set of core questions for participants to answer before the activity (Q1: at sign-up/recruitment) and after the activity (Q2) We supported teams to link Q1 and Q2 to delivery of their activities and to include extra questions relevant to their activity if needed – customisation of questions/design, linkage and timing was discussed and agreed with each team Data collection was via online survey (designed by Helix) with activity-specific web-links, and included consent for data sharing A third point of contact with participants (Q3: an opt-in Zoom interview, via consent from Q2) enabled Helix to engage directly with a sample of participants a few weeks after the activities. The purpose was to explore their answers to Q1 and Q2 in more depth and to gain a more nuanced understanding of individual responses to the activities. Schools Challenge data collection followed a slightly different plan, as follows: <ul style="list-style-type: none"> Q1 for teachers via a web-link from the micro-site and/or the downloadable resource pack Q2 for teachers linked to upload of students' competition entries Q2 only for students (no Q1) administered by teacher via a web-link from the micro-site and/or the downloadable resource pack. Incentives were offered to all participants aged 18+. This was via one entry token per unique questionnaire (Q1/Q2) or interview (Q3), with the potential for 3 entries, to 3 prize draws for £100 each of high street vouchers.
<p>Data collection 2: interviews with OCAAT project team and delivery partners</p>	<ul style="list-style-type: none"> Learning and outcomes for OCAAT project team and delivery partners: <ul style="list-style-type: none"> Reflections and experiences of new curatorial approach 	<ul style="list-style-type: none"> Zoom interviews conducted by Helix with: <ul style="list-style-type: none"> OCAAT project team Work package leads

<p>(May - Nov 2021)</p> <p>To explore the process and effectiveness of the project approach, and describe outcomes for HCA researchers and other partners</p> <p>To explore evidence of a cultural shift towards enhanced and sustained engagement with the HCA across research and public communities</p>	<ul style="list-style-type: none"> ○ Reflections on implementing project as a whole and/or delivering individual activities (successes & challenges) ○ Other personal outcomes ● Learning and outcomes for the HCA (longer term): <ul style="list-style-type: none"> ○ Reflections on extent, nature and sustainability of any evidence of culture change, improved dialogue/transparency, normalisation of language around HCA research and tissue donation, and new foundations for public engagement across the whole HCA consortium 	<ul style="list-style-type: none"> ○ City teams, including producers, artists and others as relevant/advised ○ Schools Challenge partners ○ Poetry Challenge partners ○ RCA partners.
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Annex D: One Cell At A Time evaluation - outcomes framework

OVERALL AIM OF THE PROJECT	TO BRING ABOUT A CULTURAL SHIFT TOWARDS ENHANCED & SUSTAINED ENGAGEMENT WITH THE HCA ACROSS RESEARCH & PUBLIC COMMUNITIES
<p>LONGER TERM OUTCOMES FOR THE HCA AS A WHOLE</p> <p>Progress towards over the lifetime of project</p>	<p>IMPROVED DIALOGUE & TRANSPARENCY ABOUT HCA RESEARCH Generate dialogue and transparency between HCA UK members and communities, that address questions and concerns around research and tissue donation, including use of language, GDPR and consent</p> <p>IMPROVED PARTICIPATION IN HCA RESEARCH Build a culture within the HCA where UK members seek out and value the opinions and experiences of patients and communities who donate to research studies</p> <p>MORE EFFECTIVE COMMUNICATION ABOUT HCA RESEARCH Co-develop a common language that enables HCA members to effectively communicate their work to different communities</p> <p>IMPROVED AWARENESS & UNDERSTANDING OF DONATION FOR RESEARCH Conversations within families and communities around tissue donation for research are more open and commonplace</p> <p>PUBLIC ENGAGEMENT LEGACY FOR HCA Create a foundation from which future public engagement activities across the whole HCA consortium can be built</p>
<p>SHORT TERM OUTCOMES</p> <p>End of project</p>	<p>HCA RESEARCH Communities that engage with the HCA are enabled to have a voice; to raise questions and concerns including identifying areas of unmet need; and to realise the value of their contributions to HCA research. HCA contributors (Artists, Producers and other delivery partners) recognise the part they each play to progress the work of the HCA. HCA UK members are more willing to seek out and value the opinions and experiences of patients and communities who donate to research; and have greater confidence to engage with the public through open dialogue and two-way communication</p> <p>TISSUE and ORGAN DONATION FOR RESEARCH People involved in engagement activities are enabled to share experiences, questions and concerns; and to have more conversations with their friends and family around research and tissue donation; including around use of language, GDPR, consent and open access data</p> <p>SCIENTIFIC (STEM) & MEDICINE CAREER PATHWAYS AND OPPORTUNITIES The young people and communities involved in the activities are more aware of the varied career opportunities and pathways provided through knowledge of STEM subjects and medicine</p> <p>ART/SCIENCE LED PUBLIC ENGAGEMENT APPROACHES, METHODS AND RESOURCES Art/science-focused public engagement approaches, methods and resources are trialled which recognise, explore and articulate the value of both scientific and artistic outputs and contributions; and create a foundation from which future public engagement activities across the whole HCA consortium can be built</p>

SHORT TERM OUTCOME INDICATORS	OUTCOMES FOR PARTICIPANTS	OUTCOMES FOR HCA MEMBERS
<p>Attitudinal outcomes</p> <p>Attitudes and motivations</p>	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Positive change in attitudes (value/trust) towards HCA/scientific research • Positive change in attitudes (value/trust) towards HCA/scientific researchers <p><u>Tissue and organ donation for research</u></p> <ul style="list-style-type: none"> • Positive change in attitudes around tissue donation and its use in HCA/biomedical research • Increased respect for the value of tissue donation for HCA/biomedical research • More willing to discuss wishes around research and tissue donation with families and friends <p><u>STEM and medicine career pathways and opportunities</u></p> <ul style="list-style-type: none"> • Greater interest to continue with STEM subjects and pursue a career in STEM (Schools Challenge) <p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Positive attitude towards this style of proactive learning (added by SC team) 	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Increased willingness to actively seek multiple perspectives from communities to improve their work and how they communicate with different groups • Greater confidence to engage with the public/young people about HCA research • Increased willingness to communicate with different groups about HCA research <p><u>Tissue and organ donation for research</u></p> <ul style="list-style-type: none"> • Increased respect for the value of organ and tissue donation for research <p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Increased willingness and motivation to get involved in co-creating art/science engagement activities
<p>Conceptual outcomes</p> <p>Contributions to understanding, knowledge, debates and directions in thinking</p>	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Increased knowledge about how HCA research is conducted • Increased understanding of how they can contribute to HCA research • Increased awareness of the value of their contributions to HCA research • Increased awareness and understanding of how HCA research affects them now and in the future • Increased understanding of how the body works • Increased understanding of how lifestyle and environment can affect health • Increased awareness of the concept of ‘normal’ as a temporal, situated condition that can be changed (added by CAM team) • Increased understanding of human cells (added by SC team) • Greater awareness of the visual idea of uniqueness and difference of cells – and their role as part of a larger whole (added by OX team) • Greater awareness of the vast scale of the HCA research – trillions of cells (added by OX team) <p><u>Tissue and organ donation for research (including open access data)</u></p> <ul style="list-style-type: none"> • Increased knowledge about tissue donation for HCA research • Increased knowledge about how GDPR, consent and data sharing work in relation to tissue donation for HCA research • Discussion and increased awareness of what happens to our bodies and our identities when we die (added by NCL team) <p><u>STEM and medicine career pathways and opportunities</u></p>	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Broader recognition of the part they each play to progress the work of the HCA (contributors) <p><u>STEM and medicine career pathways and opportunities</u></p> <ul style="list-style-type: none"> • Increased knowledge about how to discuss the contribution of STEM subjects to career opportunities and knowledge about health/disease

	<p>Increased awareness and understanding of the varied STEM and medicine career opportunities and pathways available</p> <p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Increased understanding of how to design a card game (added by SC team) • Increased understanding of team roles (added by SC team) • Increased understanding of how to develop and present ideas in a visual way (added by SC team) 	
<p>Capacity-building outcomes</p> <p>Transfer of people and skills through technical, artistic and personal skills development</p>	<p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Skills developed in creating new artistic and technological forms, artefacts and practices in response to HCA research (added by OCAAT team) • Skills developed to deliver interactive, purposeful learning activities (added by OCAAT team) 	<p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Skills developed in planning and delivering art/science led public engagement
<p>Instrumental/behavioural outcomes</p> <p>Altering behaviour, influencing development of policy, practice or service provision, shaping legislation,</p>	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Empowered to start conversations with family members and peers about the impact and potential of research and the HCA project • Contributed ideas (e.g. areas of unmet need) through having a voice in HCA research • Contributed towards development of effective and appropriate language used in the HCA research <p><u>Tissue and organ donation for research</u></p> <ul style="list-style-type: none"> • More conversations with friends and family around research and tissue donation <p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Involvement in and creation of new artistic forms, artefacts and practices in response to HCA research (all cities and SC) • New forms of collective creativity developed • Continued engagement with the project 	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Development of new research questions and areas for the HCA to tackle <p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Continued/increased engagement with the OCAAT programme, and with different communities, schools and young people
<p>Connectivity outcomes</p> <p>Establishing and maintaining relationships with people and communities</p>	<p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • New forms of collective creativity developed 	<p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • New connections made with artists, producers, communities and schools
<p>Affective outcomes</p> <p>Sensory, emotional and experiential responses</p>	<p><u>HCA research</u></p> <ul style="list-style-type: none"> • Engaged and excited by the work of the HCA • New emotional responses (wonder, enchantment, respect) to the vast unknown, cellular landscape of our bodies that is revealed by the HCA research (added by LDN team) • Feel empowered by having a voice in research that affects them 	<p><u>Art/science led public engagement approaches, methods and resource</u></p> <ul style="list-style-type: none"> • Enjoyment of the art/science co-creation and engagement process

	<ul style="list-style-type: none"> • Feel empowered by contributing towards effective and appropriate language used in the research • Proud to participate in the Schools Challenge (students and teachers) <p><u>Tissue and organ donation for research</u></p> <ul style="list-style-type: none"> • New feelings and responses to tissue donation – why it feels odd, separate, complex (added by CAM team) <p><u>Art/science led public engagement approaches, methods and resources</u></p> <ul style="list-style-type: none"> • Enjoyment of the activity (all cities) • Inspired by the activity (SC) 	
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