REF2021

Institution: Abertay University

Unit of Assessment: 32 Art and Design: History, Practice and Theory

1. Unit context and structure, research and impact strategy

1.1 Unit context, structure, and strategy

Abertay University's reputation for excellence continues to grow. It has been ranked the top modern university in Scotland twice since REF2014 (Guardian Good University Guide 2019; Times/Sunday Times Good University Guide 2017) – achievements to which the submitting unit has contributed significantly. This is our first UoA32 submission; staff working in design-related disciplines have previously submitted to General Engineering. Research in the School of Design and Informatics (SDI) is highly integrated, with staff from across our disciplines included in UoA32. In total 19.9 FTE academics are included. 14.2 staff from the Division of Games and Arts, 4 from the Division of Games Technology & Mathematics, and 1.7 from the Division of Cybersecurity. The school's courses in Games Development and Game Art are regularly listed among the top 25 in international rankings (Princeton Review 2014-21), and alumni from Abertay University's videogame degrees are regularly included in Develop Magazines 30 under 30 listing for their contributions to the games industry. During the REF2021 period, the school's research in Unit32 has had a growing impact in the field, as well as attracting significant external funding (including the Abertay-led £11.5M InGAME: Innovation for Games and Media Enterprise R&D centre).

We are recognised nationally and internationally for innovative, distinctive, impactful, and collaborative interdisciplinary research that follows both theoretical and practice-led inquiry in Art & Design. This focuses particularly on two thematic areas: *Performance and Play*, which approaches video games as cultural objects investigating their socio-cultural functions in relation to both society and the economy; and *Applied Games*, which integrates user experience and interaction design with development tools and techniques to design interactive works that raise awareness, facilitate learning, and foster behavioural change. Exemplary outputs evidencing the diverse and wide-ranging research activities within UoA32 include the BAFTA-nominated game art installation *Killbox* (DeLappe 2016), the high-impact monograph *Performativity in Art, Literature and Videogames* (Jayemanne 2017), and a Unit member's service as President for DiGRA (Digital Games Research Association), the largest international community of games researchers (Huber, 2016-ongoing). Such work has bolstered and expanded the excellent reputation of this Unit through efforts in research, industry partnerships, and knowledge exchange that redefine and push disciplinary boundaries.

Core to these efforts is a commitment to research practice and output of the highest standard, and investment in new forms of scholarly inquiry, public engagement, and sector partnerships. The activities of the Unit align with and are supported by the University's strategic approach to research and knowledge exchange, R-LINCS (Research-Led Innovation Nodes for Contemporary Society) framework, which was implemented in 2014. R-LINCS is organised in four central themes (Creative Industries, Environment, Security, and Society), and embodies the University's ambition to function as a hub of excellence for interdisciplinary research focussing on the development and delivery of impactful practical solutions to issues and problems (R-LINCS 2014-19). UoA32's core focus is on the R-LINCS Creative Industries theme, providing the guiding principles for how the Unit's activities are structured and how areas of expertise are organised. Notably, a Unit member (Sloan) also serves as University-wide Theme Leader for Creative Industries. In future, University-wide RKE activity will be focused on the institutional RKE strategies of 'Challenge Spaces' that address key local, national and international priorities, 'Pooled Excellence' that draws upon multidisciplinary research, and drives innovation through cross-institutional working (R-LINCS2 2020-25). UoA32 will play a leading role in the Challenges Space, Creative Industries and Cultural Vitality.

Applied Games and *Performance & Play* function as two distinct research areas within the Creative Industries theme, reflecting ambitions of interdisciplinary collaboration and industry

partnership fostered by R-LINCS, and which are well-aligned in their focus on the development of innovative, productive, sustainable, and future-oriented Sector connections. During REF2021, work in both areas has resulted in a significant increase in high-profile relationships and in national and international partnerships, leading to high impact outputs, larger audiences, and increased levels of external funding support.

Applied Games draws on its academic and industrial expertise to engage a range of research methodologies – from play as interrogation and ideation in serious game jams to data driven design in full development projects – to explore the role and value of games in education, in training, and in science communication. Researchers seek to develop new game design frameworks following practice-based approaches, for instance by applying media archaeology to game design. *Applied Games* brings together expertise in computing, mathematics, design, and psychology to develop and evaluate both hardware and software. For example, recent work in agri-tech has brought Augmented Reality (AR) technologies and Artificial Intelligence (AI) together with animal husbandry to increase efficiency and animal health.

Performance and Play explores communities of play and experimental practice-research utilising digital and traditional media, the incorporation of game development, screen technologies and extended reality (XR) applications into site-specific performance and art, and studies of performance audiences. Working closely with industrial partners (e.g., Microsoft, Sony) to explore the potentials of emerging technologies for immersive storytelling and new forms of creativity and play. Current international collaborations integrate storytelling and game development, with a focus on energy use, climate change and conflict. This includes a strong focus on immersive technologies, with research focused on novel applications of virtual, augmented, and mixed reality. Recent work includes developing an app for street level play outside the V&A Dundee during the Covid-19 lock down.

Game studies research spans both areas within UoA32 to encompass game production studies, interactive narrative, immersive storytelling, and critical analysis of games culture. In games studies, Unit members have produced high impact research outputs and practice-based collaborations, as evidenced below.

The two foregoing areas align well towards facilitating an interdisciplinary context where Unit members investigate the development and application of interactive and immersive media in cultural contexts, and develop new curatorial, exhibition and archival practices. Here, innovative ways to engage audiences with the socio-cultural impact of digital technologies are being developed, with areas of application including heritage and preservation, as well as practice-led approaches in collaboration with industry.

SDI has worked to develop its research culture by focussing on our strengths in interdisciplinary research and our proximity to industry. SDI used competitive funding from UKRI (CICP), BEIS (ISCF), and the Scottish Government (City Deal and Scottish Futures Trust) to establish R&D centres that build on established relationships, networks, and pathways to impact. This approach supports academic engagement with applied RKE opportunities and delivers impact directly into the local, national, and international economy.

Around these centres, the University built a scaffolding of support and opportunity for research collaboration and career development. Industry partners such as Sony Interactive Entertainment, Microsoft Research, and Disney Research, alongside sector agencies IDGA, UKIE and TIGA, policy makers DDCMS and Creative Scotland technology vendors such as EPIC, NVidia and AWS create an innovation-rich environment for applied R&D. Strong relationships with research organisations such as UKRI/InnovateUK, DiGRA and FDG, SGSAH, brings opportunities for funded PhD, KTP and support for training and publishing that has benefited many UoA32staff.

Interdisciplinary research and collaboration are supported by the new £5M office and research facilities made available by the University as well as highly effective unit-specific infrastructures for knowledge exchange, information sharing, development of best practices, and organisation

of research collaborations. Over the course of REF2021, these have included a monthly in-person event series (Stop Work Share initiative (Section 2)), as well as weekly Unit-wide online meetings and an online communication and collaboration platform to discuss funding opportunities, collaborative research projects, and opportunities for public-facing and sector-facing knowledge exchange.

Two large-scale research and knowledge exchange endeavours – InGAME and the Emergent Technology Centre – demonstrate the success of activities within the submitting unit. InGAME is a large interdisciplinary and cross-institutional R&D centre for innovation in the games sector, which was awarded £5.2M by the Arts and Humanities Research Council (AHRC) and £500k by the Scottish Funding Council (SFC). The Emergent Technology Centre (ETC) is a new research/project environment on campus that comprises five specialist labs and studios available for creative practice, research, prototyping, and knowledge exchange activities, and which features a partnership with Dundee City Council to deliver R&D into the city's new 5G Use Case programme (£5.5M Tay Cities Deal, UK/Scottish Government). The ETC also connects to a university-wide initiative to establish AI/machine learning and Data Science as a new multi-discipline area for research and teaching across the institution (see future strategic plans).

InGAME and the ETC align with the R-LINCS theme Creative Industries. InGAME focuses on Games, creative experimentation, and driving innovation and sector integration through diversification. The ETC focuses on the areas of Experimental Game Design; Games Programming; Real-time Animation; Virtual & Augmented Realities; and Complex Systems Visualisation. The two centres align with postgraduate teaching and research activities in the University's MProf in Games Development and MSc in Computer Games Technology and have led to the creation of a new MSc in Artificial Intelligence and User Experience.

Research and knowledge exchange efforts under the themes *Applied Games* and *Performance and Play* have led to sector development funding of roughly £6M over this REF period and the next. Funding includes the AHRC-funded knowledge exchange hub Design in Action (£520K, White 2012-2016) and the Create Converge initiative designed to improve knowledge partnerships between media businesses, knowledge institutions, public organisations, and end users (£115K, Co-Is Robertson & Szymkowiak 2016-2019). In the second half of the cycle, development of and investments in the InGAME initiative have yielded significant outcomes including the spin-off InGAME International (£0.5M from AHRC, Sloan et al. 2020-2023) and the Horizon 2020-funded TRIPLE (Targeting Researchers through Innovative Practice and Multi-Lingual Exploration) project (£353K, Co-I Szymkowiak 2019-2023).

1.2 Future Strategic Plans and Aspirations (2020-2025)
UoA32 will continue to build on current successes in *Applied Games* and *Performance and Play* to develop and diversify application areas, industry networks and international partnerships.

Crucial to our future plans is the support provided through the new research strategy (R-LINCS2 2020-2025). The University is committed to continued support for research and knowledge exchange activities that focus on interdisciplinary, innovative, and collaborative approaches to address the complex problems that face modern society. This includes continuing investment in research and knowledge exchange to strengthen the reputation of Abertay as a world leading institution in the innovative development and scholarly exploration of video games and immersive technologies.

The aforementioned ETC research facility will play a crucial role in support of future activities by providing much needed research space and access to crucial equipment while also playing a key role in facilitating innovative approaches to the utilization of the new £4M 5G Research & Development Testbed in partnership with Dundee City Council and Scottish Futures Trust located in the heart of the city. The latter will be pivotal to future research for both thematic areas as we consider how best to realise the potentials of high-speed networking in opening up opportunities for innovation ranging from game development, VR/AR, the Internet of Things, social play and performance. Further opportunities for innovation, creative development and

community engagement are anticipated considering Abertay's central role in a 4,000 seat esports arena and academy coming to the Dundee Waterfront by 2024.

Furthermore, we are committed to increasing numbers of research-active staff; investment in postgraduate research scholarships; and support for funding applications. Over the next 5 years Abertay will invest in and support c.15 fully funded PhD studentships, funded PhD studentships for newly appointed academic staff (subject to the approval of a research plan that is aligned with the R-LINCS2 objectives), Abertay Futures Scholarships, Pump Priming awards, and Open Access Publication awards.

Ultimately, there is a clear vision for continuing to develop and expand the vitality of our research environment. We will exploit the momentum behind our growing research output and impact towards solidifying our reputation as a world-leading environment for the development and scholarly consideration of gaming and immersive technologies for the betterment of the creative industries, our communities, and our future.

2. People

2.1. Staffing Strategy and Staff Development

Staffing strategy: As indicated above, UoA32 includes a total of 19.9 FTE staff coming from the three divisions within SDI: Games and Arts; Games Technology & Mathematics; and Cybersecurity. Our submission reflects a dramatic increase in research focus within the constituent divisions. The staff returned represent a balance of experience, with two professors, seven senior lecturers and eleven lecturers, of whom nine have been promoted at least once in the assessment period.

Investment in new academic staff across the assessment period has been driven by a strategic plan for improving existing research strengths. This strategy is evidenced in the eight external hires within this UoA, including the appointment of established researchers such as DeLappe (Games and Tactical Media), Zeilinger (Computational Arts & Technology) and Jayemanne (Games Scholar), and early career researchers (ECRs) such as Parker-Love (Animation and Interactive Art), Bozdog (Immersive Experience Design) and Mehrpouya (Computer Games Technology). We also welcome numerous visiting researchers who benefit from our research culture and contribute to it through seminars, masterclasses, support, and providing inspiration to ECRs and postgraduate research students (PGRS). These included international successful game developers (e.g., Ed Fries, Mary Flanagan, Philip and Andrew Oliver, and Mike Bithell) and Marie-Claire Isaaman, CEO of Women In Games, who supports the school to improve gender balance in student and staff groups.

Our recruitment strategy reflects the commitment to bring original and diverse perspectives into practice-based and scholarly research in Games, Creative Technologies, and Digital Culture. Recent appointments reflect the importance placed on international recognition; excellence in alternative as well as commercial game design; and expanded notions of community, agency, and the role of play. Our approach is to engage practitioners and scholars at a variety of career stages to develop a cohort of research staff who help shape a unique environment for excellence.

In the School of Design and Informatics, 44 new appointments were made during REF2021: 4 Professors/INGAME Director, 2 Senior Lecturers, 16 Lecturers, 5 Research Fellows, 9 Research Assistants, 4 Teaching Fellows, 1 Technician and 3 Research Project Staff.

Staff Development: Abertay is fully engaged with (and a signatory of) the Concordat to Support Research Integrity (CSRI); the Concordat to Support the Career Development of Researchers (CSCDR); the Knowledge Exchange Concordat (KEC); the Concordat on Open Research Data (CORD); and the Concordat for Engaging the Public with Research (CEPR), which we use to guide development of supportive RKE policies (see Section 2). All staff, students and visiting

researchers adhere to the highest standards of integrity in the conduct of their research as set out in the Abertay Research Code of Conduct (ARCoC) and engage in mandatory research integrity training (including GDPR for Researchers).

New staff, including ECRs, benefit from a comprehensive Induction Programme covering PGR degrees and regulations, Abertay's RKE Strategy, ARCoC, CSRI, CORD and CSCDR. Depending on experience, new staff undertake our PgCert Academic Practice (PgCAP) which includes an optional taught module on research covering regulations and policies underpinning research practice, building RKE networks, research planning and funding. All new lecturers who don't have a teaching qualification are required to undertake the PgCAP as part of their probation and are allocated time to do so. All staff are also required to complete an online Epigeum course on supervision skills before taking on PGRS.

Our **Sabbatical Policy** encourages staff to apply for sabbatical leave for research (6-12 months). The policy provides for particular consideration of leave following maternity/adoption/shared parental leave to help re-establish an employee's career and allows for sabbatical leave to be explored as positive action to promote career development for under-represented groups.

Consistent with the CSCDR, all staff have personal **Development Discussions** with their Heads of Division (HoDs) twice a year. Development Discussions appraise both short-term research objectives and long-term plans, discuss development needs, and review any well-being and workload issues. Development needs are met through the Graduate School and by HoDs.

The Graduate School has three Researcher Development Staff who, together with senior Abertay staff, provide >100 development opportunities. Training includes advanced statistics, GDPR, impact, enterprise, PGR supervision, public engagement, paper and grant writing. Where necessary, staff development needs were met by external organisations, (e.g., Fast Track Impact, Transparent and Reproducible Science training).

R-LINCS has provided PhD studentships (details below) and also awards 'pump priming' research funding. UoA32 staff have been awarded three pump priming grants (£11.5K) which have resulted in subsequent academic outputs (Parker & Galloway, *Creative Communities: Shaping Process Through Performance and Play*, 2017; Jayemane, *Chronotypology: A Comparative Method for Analyzing Game Time, 2020*) and support for Open Access publications.

Staff research has been supported by internal funding for travel, staff development, and equipment. Also supported are career development and dissemination through conference and exhibition attendance, including national events (Coventry Biennial, Now Play This, Electronic Visualisation & the Arts (EVA), Ars Electronica) and international conferences in Europe (DiGRA, EuroGraphics, Develop:Research); the USA (Games for Change, GDC, Indiecade) and Australia/Japan (DiGRA). The total allocation for direct support of staff development between the years 2014-2020 amounted to £116K.

UoA32 staff are also actively involved in the TRAMS cross-institutional mentoring scheme to access objective support for career development, in partnership with the Universities of St Andrews and Dundee, Glasgow School of Art, James Hutton Institute and Trinity College, Dublin (8 staff as mentees and 2 as mentors, equally divided between male and female staff).

Support for Interdisciplinarity and Collaboration: SDI runs regular staff research forums. In 2016 two new regularly scheduled research focused workshops/presentations/sessions, Stop Work Share and Creative Industries Research Theme meetings were implemented. Stop Work Share provides a cross-disciplinary forum across SDI for staff, PGRS and visiting scholars that is entirely focused on research. Creative Industries Research Theme meetings are an informal opportunity to meet and discuss research ideas with colleagues, share personal research, learn

about projects, hear about current funding and publication calls, and seek assistance or feedback on proposed or ongoing research.

From 2017 to 2020, as part of *Weave* programming, SDI initiated the lecture series *Platform*, which featured 19 international contributors who gave presentations attended by staff, PGRS and the public. Weave also produced exhibitions, workshops and events that connect directly into our local community. Speakers were chosen collaboratively by a committee of SDI staff working together to identify contemporary artists, game designers and scholars to provide monthly talks scheduled in off-campus, city-centre locations. *Weave* built on Dundee's status as a UNESCO City of Design to integrate the university in the cultural life of the city, and to establish new relationships and networks for grass roots engagement and development.

2.2 Research Students
We are committed to supporting a postgraduate research community that integrates theory and practice and generates new knowledge and new forms of knowledge production. The School hosts innovative doctoral projects informed by rigorous academic research and is committed to collaborative and public dissemination. We support a postgraduate research community that engages both practice, theory and methodologies corresponding to the themes of Games, Creative Technologies, and Digital Culture.

As members of the Graduate School, all postgraduate research students (PGRS) benefit from clear institutional requirements for supervision and examinations, centralised training provision, domain-specific expert tutorials, our research infrastructure, and a variety of office, studio, project, and seminar spaces. The Graduate School administers a structured system to support PGRS progress:

> **Progress panels:** students complete annual progress reports and present their work to a Review Panel to assure good progress, supervision quality and opportunity to address any issues.
>
> **Personal development planning:** Students track meetings, achievements, goals, and training needs (e.g., statistical training, impact experience) in a Vitae Researcher Development Framework system, which must be submitted for approval before the viva. This ensures that students are systematically focused on progress, and able to articulate the research, experience and wider achievements attained throughout their postgraduate training.
>
> **Annual Graduate School conference:** PGRS are required to present their research to peers, supervisors and academic staff from across Abertay. This helps students to develop presentation skills and confidence in a formal professional context.
>
> **Training:** Weekly skills-based seminars are held during term-time to meet training needs, including research methods, statistics (SPSS and R), qualitative analysis, public engagement and outreach training, academic writing, funding applications and business development.
>
> **Access to Researcher Development Officers**: providing tailored statistical support, academic advice, and peer-review (e.g., funding applications).
>
> **Funding opportunities:** students can apply to a dedicated fund for conference attendance and researcher training support.

During this REF period we awarded 11 PhD degrees and 5 MbR degrees. We have 12 continuing PhD students and 6 continuing MbR/MPhil students, which represents a sustainable and robust PGR community given the size of this UoA.

Funding for our PGRS has been secured from various external organizations (AHRC/SGSAH, SFC, Northwood Trust, MacMillan Cancer Support Scotland) and supported internally through 2 RLINCS studentships and 3 Abertay Futures Scholarships. Staff co-supervise students at external institutions including University of Dundee and the Royal Conservatoire of Scotland. Abertay is a member of The Scottish Graduate School for Arts & Humanities (SGSAH) providing our PGRS with access to expertise, resources, and training opportunities. SGSAH has provided training programmes and direct support through the Applied Research Collaborative Studentships, which have supported two PGRS during this review period.

2.3. Equality, Diversity and Inclusion (EDI)

SDI follows all policies as set out in the University Equality, Diversity and Inclusion Action Plan, which stipulates that fair and transparent procedures are operated in respect to recruitment, deployment, training, promotion and dismissal of employees. SDI has significantly improved equality and diversity during this assessment period.

SDI initiated the formation of the Division Athena Swan self-assessment team which is overseeing the submission of an Athena Swan Silver application, to be submitted in May of 2021. Staff from Games and Arts also took a central role in forming the Athena SWAN Charter at Abertay (2014) and made a successful submission for institutional Bronze status in November 2015 and renewed in 2018.

Support is given for training in gender awareness, including conferences and a range of mandatory and voluntary training. For example, since 2015, we have supported 6 SDI female staff in the Aurora leadership programme. There is also support for flexible working, maternity and paternity leave. Flexible working is fully supported, with staff enabled to work remotely where preferred or necessitated as part of the university's digital strategy. All staff in the division have undergone mandatory unconscious bias training to combat the influence of social category membership cues on decision-making, consistent with Concordat commitments.

Recruitment: Abertay has been working to improve the proportion of applications from women for academic posts. We have developed and publicised *Writing for Recruitment* guidance to raise awareness of gender differences in perceptions of wording in adverts and criteria. We also reviewed the wording on our candidate briefs to ensure that the language does not deter women from applying. Next steps include the establishment of a working group to develop further initiatives to encourage more women to apply for academic roles in SDI specifically.

In 2014, SDI included 29 academic and research staff, 5 women (17%) and 24 men (83%). As of 2021, SDI has grown significantly and improved the male/female ratio: 76 staff (25% female, 75% male (see Table 1 for recruitment equality and diversity data). Submissions to UoA32 for this assessment period reflects the gender ratio of the larger staff cohort: 24% of submitted outputs are by female researchers.

Table 1. Recruitment Equality and Diversity Data

Characteristic	Applicants	Appointments
Sex	23% Female	26% Female
Age	Average age = 36	Average age = 35
Race	26% BAME	11% BAME
Sexual Orientation	9% LGBT+	10% LGBT+
Disability	14% declared disability	11% declared disability

Promotion: In 2014, a new promotion process was adopted and a panel consisting of the Principal, Deputy Principal, all Deans, the Head of Human Resources, and an external member (usually university senior management) is convened annually to consider written submissions for promotion.

In recent years the successful promotion of women staff in SDI has been equivalent to that of men. Through the promotions process, and across the REF2021 period, 39 applications were submitted and 14 applications were successful (29% of those promoted were female (SDI has 25% female staff). Additionally, during this assessment period SDI promoted two women to HoD roles (including one to Professor) and appointed another female professor. This evidences that the action plans formulated in response to the institutional Athena application in 2018 have started taking effect. Further equality and diversity data for promotion is not presented due to the potential to identify individuals because of the small numbers involved.

3. Income, infrastructure and facilities

3.1 Income
Since 2014, SDI has invested in its research infrastructure to ensure that there is strong leadership and expertise across our priority areas of Applied Games, Performance and Play and Sector Development. Working with the University's Graduate School, SDI has developed a managed strategic approach to the acquisition of research resources and investment resulting in a total income of £2,336,761 (Figure 1) and commensurate with our rapid growth ~60% of income was in the last two years.

<u>**Figure 1.**</u> Annual research income across the REF assessment period
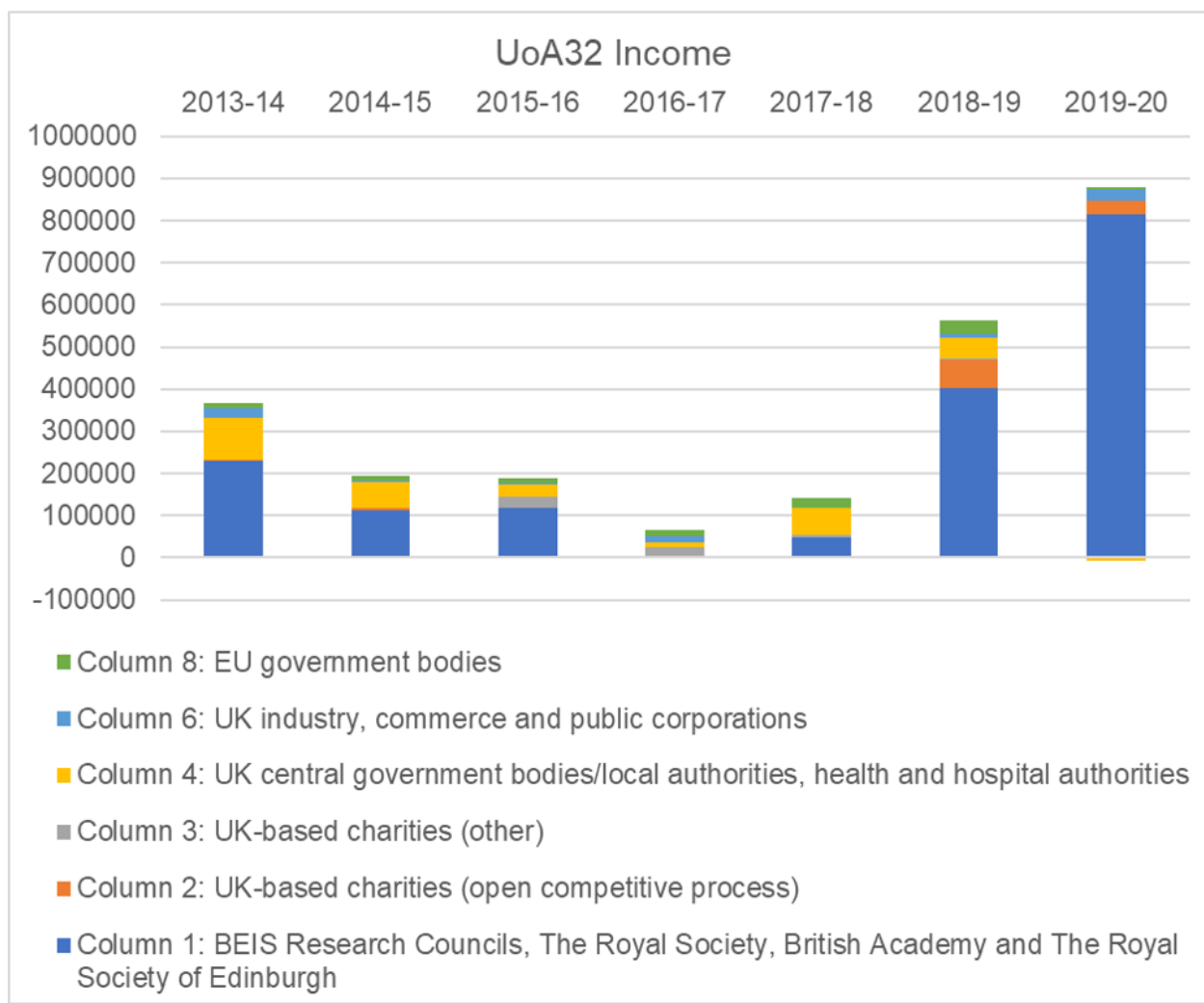
Growth in research funding is a consequence of investment in researcher development and the growing impact of research outputs in national and international economic, academic, and cultural contexts. The interdisciplinary character of our research has led to the implementation of wide-ranging funding sources, matching specific research ambitions to appropriate funding models. Below, we highlight major projects that have contributed to this pattern of income. Note that while REF 4B requires reporting on spend our narrative reports on a research/ applied research (KE) project basis to provide a clearer sense of the nature of funding received and to represent both cross-Unit and cross-REF period income generation.

<u>Applied Games</u>
Five awards have totalled £625K from funders from the UK and Europe. European Commission funding supported *STEP: Young People and Environment £178K (2015-2019)* to develop an eParticipation platform, to promote the participation of young people in the decision-making

process on environmental issues. An AHRC funded project *Visualising the Impact of the Iolaire £19K (2017)* to explore how games design and technology can enhance collective memory of the HMY Iolaire tragedy in the Outer Hebrides. This was followed by an AHRC Immersive Practices grant developing *Their Memory: Exploring Veteran's Voices, Virtual Reality and Collective Memory £60K 2018* using games design and technology and new storytelling techniques engaging hard to reach audiences with wartime memories. *Mapping for Social innovation £215K (2018 – 2021)* funded by the Northwood Charitable Trust addressing social challenges through creative, simple, and sustainable digital end products. Innovate UK supported a *Knowledge Transfer Partnership £153K (2018 – 2020)* to create the Location Indicators App, built on our existing Knowledge Transfer Partnership with National Air Traffic Services to deliver a polished prototype of a KTP Associate Design.

Performance and Play
Nine awards over the reporting period totalling roughly £214K since 2014 from diverse public sources, working with national and international cultural partners to impact new audiences. AHRC Networking Grant project *Video Games in the Museum £35K* (2014 - 2015), with the V&A London, to facilitate debate about the collection and display of video games. Scottish Graduate School of Arts and Humanities *ARC Studentship - Connecting Performance and Play £31K (2015-2018)* with the Scottish National Theatre, established interdisciplinary design methods for the development of games and performance. AHRC Immersive Experiences awards, one in collaboration with Coventry University, *Immersive Practices: Reality Remix £15K, (2017 – 2018)* engaged augmented and virtual reality for critical creative research applications exploring memory, place and performance; and S*pace, Place, Sound & Memory £10K (2017-2018)* with University of Edinburgh investigated the recreation of historic acoustic spaces virtually as a vehicle to explore medieval and renaissance performance. *Game Play £5K (2017)* from Innovate UK, Exploring Games and live performance in partnership with Poorboy and Biome Collective. *EngagePlus: Experiencing live orchestral music through technology (2017 - 2020) £4K* SGSAH studentship *w*orking with the University of Dundee and the Royal Scottish National Orchestra. Carnegie Trust award for *Design Methods Virtual Reality Games £7K (2017 – 2018):* new methods audio design in order to fully explore the expressive potential of VR. *ICHOS: Dynamic Audio for Virtual Reality and Games £90K (2018- 2019)* RSE fellowship to develop interactions of materials and movements for an all-in-one solution for dynamic audio design in VR. *RSE Digital Art & Activism £17K (2019 – 2021)* critically engages the current state of digital art/activism through workshops, an international symposium and publications.

Sector development – projects looking at ways of working with industry
Over the last decade Abertay University has worked closely with University of Dundee and University of St Andrews developing complementary skills knowledge and research capacity in relation to the theory, practice, and business of the creative and cultural industries. During the REF2014 period the University of St Andrews led the ESRC funded Institute for Capitalising on Creativity and Abertay University led the SFC funded Moving Targets; KE for the Digital Industries projects.

Following the same pattern of rapid growth as evident in Games and Arts and working with colleagues in related disciplines (UoA12), SDI has continued to work to deepen links between academia and industry in the creative industries to deliver collaborative research with impact.

UKRI and EU funded projects during the REF2021 period began with Design in Action (UoA32 returned, 2012-2016, £5.7M AHRC funding, Abertay a partner). Design in Action evidenced design as a key strategy for economic growth and innovation within industry, focusing on the value of design-led innovation across business, technology and policy. Design in Action delivered wide reach (633 SMEs attended events), income generation (£672K external funds leveraged for projects) and job creation (81 jobs through funded projects). Create Converge (EU Interreg, 2016-2021) co-returned with UoA12, £3M, (£100K to Abertay as partner in a large consortium) focuses on the convergence of creative technologies to deliver new ways of working and to reach into new markets. Key contributions from Abertay include working at the interface

between film and games for virtual production (now a new Erasmus+ project) and the design and development of bespoke controllers for interactive experiences.

Our most recent award (InGAME, £5.7M, AHRC and SFC, 2018-2023) integrates our RKE practice from Design In Action and Create Converge together with our work on Modelling & Simulation via Applied Games in both Engineering and Allied Health (UoA3). InGAME – Innovation for Games and Media Enterprise – is the UK Creative Cluster for Computer Games, co-returned with UoA12). InGAME is led by Abertay in partnership with the Universities of Dundee and St Andrews. InGAME is partnered with industry (Sony, Microsoft, 4J Studios, Outplay and others) to provide a R&D environment for new and experimental creative content, products, services, and experiences. Central to InGAME's delivery is its approach to innovation. We have developed the InGAME Applied Games Lab that enables industry to work directly with our R&D team to harness the power of computer games to solve real-world problems, codesign challenges and de-risk those solutions through project scoping and prototyping. To date InGAME, at its mid-point, has delivered 28 outputs (R&D projects, innovation labs, bootcamps etc.), has supported 17 companies with its R&D voucher scheme and provided networking and training opportunities to >700 people.

InGAME has already led to three spin-out funded projects. First, InGAME International (co-returned with UoA12) is a £0.5M AHRC funded project (2020-2023, match funded by partners in China) to identify policy and regulatory barriers to cooperation and develop new modes of working to create innovative new products, services, and business models. Informed by a series of demonstrators we are developing guidelines for industry, academic programmes, and professional training to ensure that new generations of games professionals are equipped to work with researchers to innovate new products for international markets. Second, SmARtview is a spin-out of our InGAME Applied Games Lab (50x return on investment) funded by Innovate UK (£250K total, led by AgriEpi Innovation Centre with Pocket Sized Hands games SME and Abertay (£75K of funding, co-returned with UoA12), 2020-2022). SmARtview is developing an AI-powered Augmented Reality tool underpinned by machine learning to improve animal health and productivity. Third, and awarded in December 2020, we are working with the UK Government Department for Digital, Culture, Media & Sport to provide a rapid evidence assessment of loot-boxes and computer games to inform government policy.

Going forward, and as noted in Section 1, *Applied Games* and *Performance and Play* will play a major role, together with Engineering (UoA12) and Cybersecurity in our new consortium (Dundee City Council, Scottish Futures Trust, Abertay) to deliver impact in our £4M 5G Research & Development Testbed located in the heart of the city. Central to delivering growth and value in the sector is the experimentation – innovation – diversification model of InGAME and deep engagement with industry partners in creative and cultural industries and creative technology sectors.

Adjacent to the 5G testbed, and at an even more ambitious scale, Northern Lights Arena Europe Ltd, Dundee City Council and lead InGAME partner, Abertay University, announced plans to bring a revolutionary new 4,000 seat esports arena and academy to the Dundee waterfront by 2024 at an estimated cost of £40-60M. This new development will stimulate new R&D and educational opportunities in the esports domain and further cement Abertay's and Dundee City's role as a world leader in computer games.

3.2 Infrastructure and facilities:
The Unit has continued to enhance the research environment with substantial investment in physical infrastructure. SDI was formed in 2015 to integrate Art & Design, Modelling & Simulation and Cybersecurity into a single collaborative working environment with a shared research space. In 2019, SDI facilities were upgraded with extensive renovations, including the recreation of White Space, new staff offices and labs in support of teaching and research in the form of the new ETC (Emergent Technology Centre). Investment for the SDI refurbishment including the ETC was £5,487,895. Our HIVE (Human Intelligent Virtual Environment) was retrofitted prior to being included as part of ETC at a cost of £32,561.

The ETC is a 400 m^2 facility comprised of five specialist labs and studios that can be used for creative practice, research, and knowledge exchange activities, as well as events and specialist teaching or training. The primary purpose of the ETC is to provide a collaborative facility for research and practice, centred on novel digital technologies. This includes: software applications and approaches, such as game engines and visualisation tools; hardware innovations, such as new screen and projection technologies, game controllers; user input devices, assistive technology; digital and physical prototyping, such as photogrammetry and 3D printing; connected technology, such as 5G and online platforms.

The addition of InGAME, will provide a state-of-the-art research space where staff and PGRS are invited to engage in innovative and cutting-edge research with research fellows, staff from partnering institutions (University of St. Andrews and University of Dundee) and partners in the creative industries.

4. Collaboration and contribution to the research base, economy and society

Collaboration with both external partners and internal colleagues is central to our research and includes a range of consultancies, service within public institutions, collective activities between designers/artists and other producers, key positions within publishing, curatorial, displaying and disseminating, cultural organising and the public presentation of knowledge. Our modes of collaboration are intrinsic to our teaching; for instance, through their research connections staff organise opportunities for students to work with industry partners and cultural institutions on curriculum-related projects.

External Collaborations
We collaborate with a range of academic institutions and stakeholders from throughout the UK and internationally. Collaborations have been supported by funding supported by UKRI council-funded research projects, SFC funded knowledge exchange, EU Horizon and Erasmus+ research and academic collaborations. Academic collaborations with other Scottish universities include: University of Dundee; University of St. Andrews; Edinburgh College of Art; Glasgow School of Art; Gray's School of Art and the Scottish Graduate School of Arts and Humanities.

Across the UK we work with University of the Arts London, Royal Holloway University and University of Hertfordshire on funded digital creative industries projects. Internationally, we have funded projects with the Royal Danish Academy of the Arts, the Norwegian Film School, Zagreb Academy of the Dramatic Arts, the Cologne Game Lab, MOME Budapest and University of Southern California. A current UKRI funded research project in Shanghai has led to a new collaboration with Shanghai Academy of Social Science, and Shanghai Theatre Academy among others.

Abertay University has targeted research collaboration as a strategic priority in order to pool resources and compete for resources on capacity and scale as well as depth and excellence. The School of Design and Informatics has enjoyed considerable success in establishing collaborations to drive creative practice and applied research in novel and emerging areas.

Academic Partnerships
- Bozdog and Sloan: 2017-2020, St Andrews University, University of Edinburgh, The Watt Institution Greenock, The McLean Museum Greenock, Sugaropolis
- Bown, DeLappe, Donald, Galloway, Sloan, Szymkowiak, White 2019-2023, University of St. Andrews, University of Dundee, InGAME (Innovation for Games and Media Enterprise) AHRC CICP
- Jayemanne & DeLappe, 2017, University of Coventry, Reality Remix – AHRC Immersive Experiences

- Donald, 2015, Erasmus Exchange Scholar to IIM, Pôle Universitaire Léonard de Vinci Paris; 2017, University of the Highlands & Islands and Isle of Lewis heritage organisations, Visualising the Iolaire.
- Lyons, 2017, University of Dundee, Color Specs.
- Mehrpouya, 2016, Leeds University, Centre for Research in Digital Education, Coding the MOOC: RTD
- White, 2014-15, University of Southern California, V&A Research, Danish Film School, Cologne Game Lab, University of Malta. MOME Budapest, NHTV Breda, Video Games in the Museum; 2012-16,
- Sloan, 2017-2018, University of Dundee, Dundee and Me: How the City Shapes our Moods; 2017-2018, University of Dundee, A Computer Game to Educate the Public About Cancer Progression.
- Sloan 2019-22, Shanghai Academy of the Dramatic Arts, Shanghai Theatre Academy, China
- White, 2012-2016 University of Dundee, Abertay University, ECA, GSA, Grays School of Art: Design in Action. AHRC Creative Economy KE Hub Design in Action (DiA)
- White, 2918 – present Co-Director, Creative Economy Hub. AHRC Scottish Graduate School for the Arts and Humanities. Sixteen HEIs across Scotland plus 29 supporters from the arts, culture, creative & heritage sectors.
- White & Szymkowiak 2015 to present. Management Board, Scottish Informatics and Computer Science Association. SICSA members comprise all 14 Informatics and Computing Science Schools in Scottish Universities. The coordinating SICSA institutions are University of Edinburgh, University of Glasgow and University of St Andrews.
- White 2020. DREEm: Experience Economy Project Board, University of the Arts London
- White, 2018 – Present. VPASSH Vice-Principals of Arts, Social Sciences ad Humanities Forum. All Scottish HEIs.

Non-academic external partnerships

Collaborations and partnerships with non-academic institutions and industry are typically engaged by our researchers to develop impact in the wider community. A characteristic of our external partnerships is the way in which staff from across the UoA use forms of game design and digital media within a range of collaborations to connect, inspire and impact upon stakeholders, audiences, and participants. The examples below demonstrate how collaboration with stakeholders across industry, charities, government, and communities have resulted in impact on the economy, health and wellbeing, education, and culture.

- Bozdog, Love, 2019, Collaboration/Commission V&A Dundee, Socially Distanced Playscape.
- DeLappe, *Upsticks*, 2019, app development: Abertay Mprof students, V&A Design Museum and Gramazio Kohler Research and students of the MAS Architecture and Digital Fabrication at ETH Zurich.
- Huber, Brennan, 2019, V&A Dundee, co-produced workshops on game-exhibit curation, outreach and knowledge exchange for *Videogames: Design/Play/Disrupt*.
- Huber, 2018, Sviluparty Games Festival, Italy, publication of "Game studies in the Cinquecento" in Ludica, Annals of the history and culture of games.
- Jayemanne, 2020, in partnership with the Fair Play Alliance and Roblox White Paper developed "Children's Safeguarding in Online Games".
- Love, 2016-2018, Collaboration with Carnegie House Museum, Dunfermline, game development project; 2020 – Present, Collaboration with Dundee City Council, InGAME and Sculptor Lee Simmons on Whale Song Park, a large-scale digital playpark at Dundee's waterfront.
- Mehrpouya, 2015-2016, Glasgow Children Hospital in Minecraft, working with Glasgow Children Hospital Charity, Scotland
- Szymkowiak, 2019-2023, Triple (Targeting Researchers through Innovative Practices and multiLingual Exploration), working with CNRS – HumaNum.

Consultancy

Consultancy and Advisory in Industry

- Galloway, 2015-16, Creative Skillset Network: Industry Advisory Board; 2020-21 ScreenSkills - National Occupational Standards for Interactive Media and Computer Games – Steering Group
- White, 2010 – present Sony PlayStation First academic Advisory board, 2016: Women in Games Management Board; 2014-17: Sector Working Group (Games) Member, CREATe, RCUK; 2018-pesent. V&A Dundee Design for Business Management Board; 2012-15 - Creative Skillset National Board Scotland.

Consultancy and Advisory in Cultural and Public Sector Institutions

As the leading institution in the UK for videogame education, Abertay University has led the development of the subject and discipline as an academic field as well as a cultural form. The expertise of staff from the school of Design and Informatics is regularly sought to contribute to economic, social, and cultural policy development.

- DeLappe, Brennan, 2019-present, V&A Dundee Abertay Advisory Group
- White, 2020, Experience Economy Project Board, University of the Arts; 2018: A Cultural Strategy for Scotland Academic Consultation Group. Scottish Government
- Zeilinger, 2018 to present, International Advisory Board, Digital Communities, Prix Ars Electronica
- White, 2018 -- A Cultural Strategy for Scotland Academic Consultation Group. Scottish Government
- White, 2019/20 – Academic advisor CODE: Centre of Digital Excellence, Dunedin, New Zealand

Advisory and Editorial Boards

- Bozdog, 2019-present, Co-editor Scottish Journal of Performance – special issue *Art of Care*.
- DeLappe, 2020-2021, Guest editor special issue *Re@ct*, Media-N: The Journal of the New Media Caucus
- Zeilinger, 2019-2020: Guest editor for a special issue of the journal Frontiers in Blockchain.
- Szymkowiak, Editor, Frontiers in Human Neuroscience

Prizes, indicators of esteem, and positions of influence

Selected Awards

- Bozdog, 2017, IGDA Scholars - Women in Games Ambassador Studentship 2017
- DeLappe, 2019 NetArt Honoree, Webby Awards, Academy of Digital Arts and Sciences (IADAS); 2017, Guggenheim Fellowship, John Simon Guggenheim Memorial Foundation, New York, NY; 2016, Nominee, Kill Box, Best Computer Game, BAFTA Scotland
- Michalokos, 2018, Royal Society of Edinburgh Enterprise Fellow; 2018, Converge Challenge '18 Finalist; 2016, New Interfaces for Musical Expression - Conference Award

Collections

- DeLappe, The Imperial War Museum, London, United Kingdom; BAMPFA, Berkeley Art Museum and Pacific Film Archive, Berkeley, CA

Selected Visiting fellowships and residencies

- DeLappe, 2015, Autodesk AIR, Artist in Residence Program, San Francisco, USA; 2015; Artist in Residence, Grand Central Art Centre, Santa Ana, USA;
- Zeilinger, 2018, Research fellowship, "Rethinking Affordance," Akademie Schloss Solitude, Stuttgart; 2015, Research-Creation Residency, Signal Culture Experimental Media Art Center, Owego/USA

- White, 2019: Visiting Professor: Dundee University, Duncan of Jordanstone College of Art and Design

Selected Professional body memberships
- Brennan, Member of Unesco Dundee Core Group.
- DeLappe, Donald, Moody, Biome Collective, Dundee
- Donald, Royal Society of Edinburgh, Young Academy Member
- Huber, Member of the National Expert Group on Digital Ethics
- Jayemanne, Diversity Special Interest Group, DiGRA
- Michalakos, JAMES (Joint Audio Media Education Service) Member
- Prior, Professional member of Association for Computer Machinery.
- Szymkowiak, Abertay Representative SICSA (Scottish Informatics and Computer Science Alliance)

Selected Reviewing of papers
- Sloan, The Computer Games Journal (2014-)
- Sloan, Gaming and Virtual Worlds (2017-)
- Bozdog, Book Peer Review: MIT Press
- Huber, Reviewer for Games & Culture (SAGE Publications)
- Zeilinger, AI & Society; Philosophy & Technology; and Oxford Journal of Legal Studies.
- Prior, Journal of Transactions on Accessible Computing, Journal of Information Technology and People.
- Jayemanne, Reviewer for ToDIGRA, Games & Culture journals
- Szymkowiak, International Journal of Technology and Human Behaviour

Selected Grant reviewing activities
- Sloan, AHRC Peer Review College (2017-)
- White, 2020: Ad-Hoc Reviewer UKRI COVID_19 Funding call; 2018; and Strategic Review College Member – AHRC; 2018.
- Szymkowiak, 2019, Carnegie Trust Panel.
- Donald, 2018 Peer Review College – UKRI

Selected Judging/jurying panels
- Sloan, 2017-2018, jury, AMAZE.
- Lyons, 2015, Impact 9 Print Conference, Hangzhou China
- Prior, ACM CHI Conference
- Jayemanne, 2019-2020, Jurist – Prize in Narrative Excellence, Independent Games Festival
- DeLappe, 2020, Residency Award Museum of the Moving Image, NYC

Selected Conference and Festival leadership
- Brennan, Bozdog, DeLappe, 2012-2019 curatorial and organizing committee, NEoN Digital Arts Festival, Scotland
- Brennan, Galloway, Sloan, 2016, co-organized DiGRA (Digital Games Research Association) and FDG (The International Conference on the Foundations of Digital Games), Dundee
- DeLappe, 2019, Co-Chair Re@ct: Social Change Art Technology, Dundee
- King, 2018, organised the 19th International Conference on Intelligent Games and Simulation, Dundee
- Huber, 2016, Hosted the First Joint International Conference of DiGRA and FDG, Dundee
- Huber, 2016 to present, President of the Digital Games Research Association (DiGRA), producing international conferences in Melbourne, Australia, Turin, Italy and Kyoto, Japan.

- Jayemanne, 2020, Game Engines Beyond Games Symposium, Babycastles Gallery NYC & Mozilla Hubs.
- Love, 2020 – present, Board Director, Now Play This: A Festival of Experimental Game Design, London
- Mehrpouya, 2014-2016, committee member, EVA Conference, Europe.
- Zeilinger, 2018, Lead organizer Rethinking Affordance, Akademie Schloss Solitude, Stuttgart, Germany

Selected Keynote speakers
- DeLappe, SCIFI-IT 2020, 4th Annual Science Fiction Prototyping Conference, Ghent University, Belgium
- Huber, 2019 Games and Geopolitics, Moscow, Russia
- Jayemanne, 2019, Ludic Literature, University of Glasgow.
- Mehrpouya, 2014, ICT & Art Connect, Brussels, Belgium
- White, 2018: Session Keynote, UK/China Creative Industries Partnership Development Workshop, Shanghai; 2017

Selected Invited speakers
(highlights from research featured in over 60 invited talks internationally):
- Michalakos, 2019 Improvising with Live Electronics - Seminar / Norwegian Academy of Music, Oslo
- Galloway, 2019 National Crime Agency Cyber Prevent Network Conference, Invited Speaker.
- Zeilinger, 2018: "The Ends of Appropriation." Invited lecture at the 'Re-' Research Network, CRASSH, Cambridge University, Nov 30.
- Mehrpouya, 2017 Guest lecturer for a week-long Games for Change module at Pôle Universitaire Léonard de Vinci. (2017)
- Jayemanne, 2019   30-31 March. BBC Radio 3 Free Thinking Festival 2019, Sage Gateshead: "How They Manipulate Our Emotions"
- Donald, 2011 – 2015 Visiting Lecturer, BBC Academy, 2011-2015
- DeLappe, artists lecture, Game Politics, Goethe Institute - Istanbul, Turkey

Exhibitions/ and Performances
(highlights from research featured in over 50 events internationally):
- DeLappe, Open World: Video Games & Contemporary Art, Akron Art Museum, Akron, Ohio
- Love, Ola De La Vida. (2017). [Installation]. FuturePlay Tech Zone, Edinburgh International Fringe Festival.
- Lyons, EpiGenSys: Visions of Epigenetics, invited artist. Paris France.
- Michalakos, 2019 / Performance / ACM Creativity & Cognition (San Diego 2019)

Knowledge exchange and outreach activities
Industry facing talks/workshops
(highlights from research featured in over 25 events):
- Brennan, 2018: Guest speaker the British Council Galloway, 2015 Connecting Performance and Play. Knowledge Exchange Network, National Theatre of Scotland, Dundee Rep, Abertay University.
- White, 2019: Panel Member, UK-China Creative Industries. UKRI China
- Love, Love, L., & Hamilton, M. (2019). [workshop with 25 Play practitioners and academics] You are invited to… play, chalk and talk with #oneplaything. 120-120. from Play Perform Learn Grow, Thessaloniki, Greece.

Outreach
Our research staff are typically involved in various outreach activities, highlights include:

Brennan, 2018-2019: Leading the design and delivery of Bright Ideas - a creative learning journey for Widening Access pupils in Higher Education, from all secondary schools across the city.

- Brennan, 2018-2020: Platform - Leading a team of academic staff to deliver a monthly talk series, bringing established external creative practitioners for a diverse local audience.
- Bozdog, Generation ZX(X) – with NEoN Digital Arts Festival and Creative Scotland, Douglas Community Centre, Hot Chocolate Trust, Weave by Abertay, The Royal Conservatoire of Scotland, The National Theatre of Scotland, Loadsaweeminsinging, Dundee City Council - Dundee's Art Galleries and Museums
- Love, Cadbury's Heroes League Partnership 2020 – to promote the benefits of social play to families and the public in a national campaign. Interviewed by regional and national radio (10+ stations), regional TV (ITV England) and Ladbible.
- Jayemanne, 2017 Abertay Faculty representative at the IGX Show, Mumbai, India.