Breaking Down Barriers

Usability, Accessibility and Inclusive Design

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Editors
Pat Langdon
Department of Engineering
University of Cambridge
Cambridge, Cambridgeshire
UK

Jonathan Lazar
Department of Computer
and Information Sciences
Towson University
Towson, MD
USA

Ann Heylighen
Department of Architecture, Research[x]
Design
University of Leuven
Leuven
Belgium

Hua Dong
College of Design
and Innovation
Tongji University
Shanghai
China

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Preface

The Cambridge Workshops on Universal Access and Assistive Technology (CWUAAT) are a series of workshops, which is held every 2 years at Fitzwilliam College in Cambridge University. This volume, *Breaking Down Barriers*, comes from the 9th workshop in this series held in April 2018.

In the context of developing demographic changes leading to greater numbers of older people and people living with impairments, the general field of inclusive design research strives to relate the capabilities of the population to the design of products, services and spaces. CWUAAT has always had a successful multidisciplinary focus, but if genuine transdisciplinary fields are to evolve from this, the final barriers to integrated research must be identified and characterised. Only then will benefits be realised in an inclusive society. Barriers do not arise from impairments themselves but, instead, are erected by humans, who often have not considered a greater variation in sensory, cognitive and physical user capabilities. Barriers are not only technical or architectural but they also exist between different communities of professionals. Our continual goal with the CWUAAT workshop series is to break down barriers in technical, physical and architectural design, as well as barriers between different professional communities.

The main sections of this book reflect the themes that we have identified in the emerging field of design for inclusion:

I Breaking Down Barriers Between Disciplines: Different disciplines, such as Engineering design, Assistive Technology, and Architecture and Medical design, are poor at communicating to each other on the basis of their approach to inclusive design and their criteria for good research in inclusive design;
II Breaking Down Barriers Between Users, Designers and Developers: A specific problem has been identified as the relationship between designers and the likely end users of their products or services;
III Removing Barriers to Usability, Accessibility and Inclusive Design: These different sub-disciplines of human computer interaction and user centred design actually evolved from similar roots. Nevertheless, despite some consideration of

ageing and impairment in each field, they do not share a common theoretical or practical framework as a basis for progress;
IV Breaking Down Barriers Between People with Impairments and Those Without: It is an important consideration during the design or development of inclusive products. In particular, new ways of working together with disability have to be found if we are to realise the potential of this area. This includes collaborative, participative and user-centred design but also addresses each designer and user at the social–cultural level;
V Breaking Down Barriers Between Research and Policymaking: Here, important deficiencies have been identified in the translation of inclusive understanding into policy and practice. Hence, despite the existence of inclusive laws and guidelines based on inclusive research and the presence of websites, services and products that are predicated on them, considerable barriers have emerged in the access, use and construction of these offerings. Very often this affects the very population they were intended to serve.

The greatly appreciated aspect of these workshops is that they are a single session running over 3 days in pleasant surroundings with many delegates from home and abroad staying on site. CWUAAT allows speakers longer presentation times and question sessions, carrying discussion on through the day into plenaries. The shared social, temporal and leisure spaces generate an enjoyable academic environment that is both creative and innovative. CWUAAT is one of the few gatherings where people interested in inclusive design, across different fields, including **designers, computer scientists, engineers, architects, ergonomists, ethnographers, policymakers and user communities, meet, discuss and collaborate**. CWUAAT has also become an international workshop, representing diverse cultures including Portugal, Germany, Trinidad and Tobago, Canada, Australia, China, Norway, USA, Belgium, UK and many more.

This book contains the reviewed papers from CWUAAT 2018 that were invited for oral presentation. The papers that have been included were selected by peer review carried out by an international panel of currently active researchers. The chapters forming the book represent an edited sample of current national and international research in the fields of inclusive and architectural design, universal access, engineering design, HMI, and assistive and rehabilitative technology.

We would like to thank all those authors and researchers who have contributed to CWUAAT 2018 and to the preparation of this book. We would also like to thank the external reviewers who took part in the review process. Many thanks are also due to the reviewing members of the Programme Committee who have renewed their intention to support the workshop series. We are grateful to the staff at Fitzwilliam College for their patience and help. We must also thank the contributors of images for the cover and these are acknowledged as follows:

The wheelchair in the snow—Megan Strickfaden, University of Alberta
The wall—Natalia Pérez Liebergesell, KU Leuven
The map—Jo-Anne Bichard, 'Our Future Foyle', www.futurefoyle.org
The car—Miles Garner, RDM, UK Autodrive

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Pat Langdon
The CWUAAT Editorial Committee

Contents

Contributors

R. Alwani Royal College of Art Helen Hamlyn Centre for Design, London, UK

R. Alyami Department of Computer Science, University of Reading, Reading, UK

T. Amanatidis Department of Engineering, Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

M. Annemans Department of Architecture, Research[x]Design, KU Leuven, Leuven, Belgium

J. Bichard Royal College of Art Helen Hamlyn Centre for Design, London, UK

M. Bradley Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

O. Bradley Unilever, Leatherhead, England, UK

C. Bridge UNSW, Sydney, Australia

K. Bueter Faculty of Architecture, Technische Universitaet Dresden, Dresden, Germany

S. Carmien Human Computer Interaction Research Group, Department of Computer Science, University of York, York, UK

J. Chakraborty Towson University, Towson, MD, USA

Y. M. Choi Georgia Institute of Technology, Atlanta, GA, USA

P. J. Clarkson Department of Engineering, Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

S. Danschutter Belgian Building Research Insitute, Limelette, Belgium

J. S. Darzentas Human Computer Interaction Research Group, Department of Computer Science, University of York, York, UK

B. Deroisy Belgian Building Research Insitute, Limelette, Belgium

T. Dickerson Department of Engineering, Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

M. Ferati Oslo and Akershus University College of Applied Sciences, Oslo, Norway

G. A. Giannoumis Oslo and Akershus University College of Applied Sciences, Oslo, Norway

J. Goodman-Deane Cambridge Engineering Design Centre, the University of Cambridge, Cambridge, UK

T. V. Heitor University of Lisbon, Lisbon, Portugal

A. Heylighen Department of Architecture, Research[x]Design, KU Leuven, Leuven, Belgium

P. Jellema Department of Architecture, Research[x]Design, KU Leuven, Leuven, Belgium

M. Karam Kings College London, London, UK

M. Kevdzija Technische Universität Dresden, Dresden, Germany

J. Kirch Network Aging Research, Heidelberg University, Heidelberg, Germany

S. Kreiser Faculty of Architecture, TU Dresden, Dresden, Germany

D. Krivonos Oslo and Akershus University College of Applied Sciences, Oslo, Norway

P. M. Langdon Department of Engineering, Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

Jonathan Lazar Department of Computer and Information Sciences, Towson University, Towson, MD, USA; University of Pennsylvania Law School, Philadelphia, PA, USA

Y. Liu Department of Engineering, Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

G. Marquardt Faculty of Architecture, Technische Universität Dresden, Dresden, Germany

W. Moody Cambridge School of Art, Anglia Ruskin University, Cambridge, UK

J. Morris Shepherd Center, Atlanta, GA, USA

A. Mouzakitis Jaguar Land Rover Research, Coventry, UK

N. Nguyen Towson University, Towson, MD, USA

U. Pandya Wayfindr, London, UK

C. M. Pereira University of Lisbon, Lisbon, Portugal

U. Persad The University of Trinidad and Tobago, Arima, Trinidad and Tobago

H. Petrie Human Computer Interaction Research Group, Department of Computer Science, University of York, York, UK

T. Pey Royal Society for Blind Children, London, UK

E. Raby Royal College of Art Helen Hamlyn Centre for Design, London, UK

Jennifer Ann Rode University College London, London, UK

Paul A. Rodgers Imagination, Lancaster University, Lancaster, UK

E. Rudolph Faculty of Architecture, TU Dresden, Dresden, Germany

L. Skrypchuk Jaguar Land Rover Research, Coventry, UK

J. Spencer Royal College of Art Helen Hamlyn Centre for Design, London, UK

M. Strickfaden Department of Human Ecology, University of Alberta, Edmonton, AB, Canada

P. Waddingham Cambridgeshire Community Services NHS Trust, Cambridge, UK

T. Wallace Shepherd Center, Atlanta, GA, USA

S. D. Waller Department of Engineering, Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK

H. Wei Department of Computer Science, University of Reading, Reading, UK

J. West Royal College of Art Helen Hamlyn Centre for Design, London, UK

E. Winton Imagination, Lancaster University, Lancaster, UK

Part I
Breaking Down Barriers Between Disciplines

Creating an Inclusive Architectural Intervention as a Research Space to Explore Community Well-being

J. Bichard, R. Alwani, E. Raby, J. West and J. Spencer

Abstract This paper outlines a 2-year active design research project coordinated in collaboration with Public Health Northern Ireland and set in the city of Derry/Londonderry to explore how inclusive design methodologies can produce interventions to improve community well-being. The research focuses on the waterfront of the River Foyle and how an inclusive architectural intervention challenged the areas' negative associations. In the last decade, the waterfront has become synonymous with mental health crisis and suicide. This has led to the phrase 'I'm ready for the Foyle' becoming embedded within the communities' language as a colloquial term for stress. This project seeks to extend inclusive design within the community, creating well-being spaces around the bridges and banks of the river, with outcomes focused on drawing people to the area as a place of celebration and life-affirming activities. The project has helped to develop Inclusive Design as a means of engaging a whole city in the redesign of public spaces for improved well-being.

1 Introduction

Historically, the city of Derry/Londonderry has a turbulent past in which the river has acted as a 'natural' divide between opposing communities. In a region where peace is relatively new, tensions remain regarding access to shared resources.

J. Bichard (✉) · R. Alwani · E. Raby · J. West · J. Spencer
Royal College of Art Helen Hamlyn Centre for Design, London, UK
e-mail: jo-anne.bichard@rca.ac.uk

R. Alwani
e-mail: ralf.alwani@network.rca.ac.uk

E. Raby
e-mail: elizabeth.raby@network.rca.ac.uk

J. West
e-mail: jonathan.west@network.rca.ac.uk

J. Spencer
e-mail: jak.spencer@rca.ac.uk

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This division required careful organisation to avoid separate research enquiries with each community but to also draw on the neutrality of the river as a symbol of the shared home of the city.

Inclusive Design is a way of designing products, services and environments that include the needs of the widest number of people as possible. It is often used to understand marginalised, overlooked or vulnerable populations to help innovation for the good of society. This project seeks to understand how inclusively designed interventions can improve community well-being.

Through our initial engagements with community representatives, mental health professionals, police and rescue services, a story emerged around the river that told of an Orca's visit to the city at the height of 'the Troubles' in the 1970s. The whale was seen in the river for nearly a week, was reported in the press and given the name 'Dopey Dick'. Many people visited the River Foyle to witness their unusual guest and for many children, it was their first experience of meeting others from across the river. This historical encounter was a shared community memory that conjured a positive recollection of a period that has previously been linked to destruction and violence. With the need to develop a neutral space in which to extend inclusive design with the larger community, the tale of 'Dopey Dick' provided the impetus for the design of an architectural intervention as shared research space.

Created in collaboration with community activists and creatives within Derry/Londonderry, the structure of a whale was designed and built as a space for the communities to come together. Within this space, the research team was able to organise inclusive and interactive activities to begin the process of exploring how well-being is perceived and how suicide prevention might be understood and tackled. The structure was subsequently featured in news reports and was a major attraction at two city events drawing crowds of up to 80,000 people. This paper reflects on the creation of this research space and how this shared history opened a space of design-led navigation of the city's and communities' response to well-being, the design initiatives and briefs that have emerged from these engagements and how this might offer key learnings for understanding how the design of the built environment may afford positive mental health opportunities.

2 Addressing Suicide in Derry/Londonderry

The World Health Organisation (WHO 2014) report *Preventing suicide: A global imperative* found that suicide is a major public health concern and estimated that globally, every 40 s a person will die by suicide. Northern Ireland has the highest suicide rate of the UK nations, which has increased dramatically over the last 30 years (Samaritans 2017) with Derry/Londonderry identified as the city with the highest rate of suicide in Northern Ireland (MHFI 2013). Instances of young male suicide, noted by *The Atlantic* as 'the ceasefire babies', are at 'crisis' level (McKee 2016). Within the locality of Derry/Londonderry, the term 'I'm ready for the Foyle'

has become embedded within the city as a saying associated with feelings of despair, distress or desperation, and is associated with suicide by jumping, notably from one of the three bridges that crosses the city's river.

Knapp et al. (2011) estimate that each instance of suicide in the UK has a cost equivalence of £1.7 million. Their calculations include direct costs, i.e. the services used by the individual leading up to and immediately following the suicide; GP visits, prescribed medication, counselling, funeral costs, court costs, use of emergency services, insurance claims and medical services. Indirect costs encompass the costs to society of each suicide including time lost from work, lost production from an exit or absence from the workforce. Consideration is also noted towards the human cost such as lost years of disability-free life in addition to the pain and grief experienced by family and friends.

The Public Health Agency (Northern Ireland) have looked at traditional approaches to addressing suicide prevention involving rivers and bridges but often found possible resolutions ineffective or failing to address the core reasons why people choose to die by suicide. The Agency also acknowledges that the Foyle area is a very unique situation; it is not just about the river itself, but why people are attracted to it as a means of suicide.

The River Foyle is a natural formation within the urban area of Derry/Londonderry Northern Ireland (Fig. 1). The riverfront is a six-mile loop with three bridges connecting the areas known as city-side and waterside. The largest bridge in Ireland spanning 866 m is the Foyle Bridge. To the south of the city is the Craigavon Bridge, one of the few double-decker road bridges in Europe. Between these two iconic structures is the newest bridge, the Peace Bridge a pedestrian-only walkway. The east bank of the river has a railway line (towards/from Belfast) that runs along its edge, and acts as a boundary between the water and pedestrian walkways. The river's east banks include large areas of park and wetland with residential clusters. The west bank is more urban and includes a hardscape riverfront. There are some commercial and residential blocks in the centre, whereas the south-west of the riverfront is disconnected to the city centre by a busy road. The north-west of the site emerges into a retail park and then industrial land connected along the water's edge to a nature reserve which encompasses the Foyle Bridge.

In the context of the River Foyle, individuals have lost their lives to suicide which, as Knapp et al. suggest, has an associated economic cost. However, this cost does not include unreported cases and individuals that have not lost their life but that have been intervened with at the river's edge. The cost of such attempts is undetermined.

The more intangible but central impact of suicide is how it affects the mental health and well-being of friends, family, the community and a place. Suicide in a public place can lead to further instances and spaces can become stigmatised. San Francisco's Golden Gate Bridge holds the reputation as the world's leading suicide destination, whilst England's Beachy Head holds a similar reputation in Europe. Suicides that occur in public places have far-reaching consequences for the health of others and thereby contribute to the overall burden of mental illness and

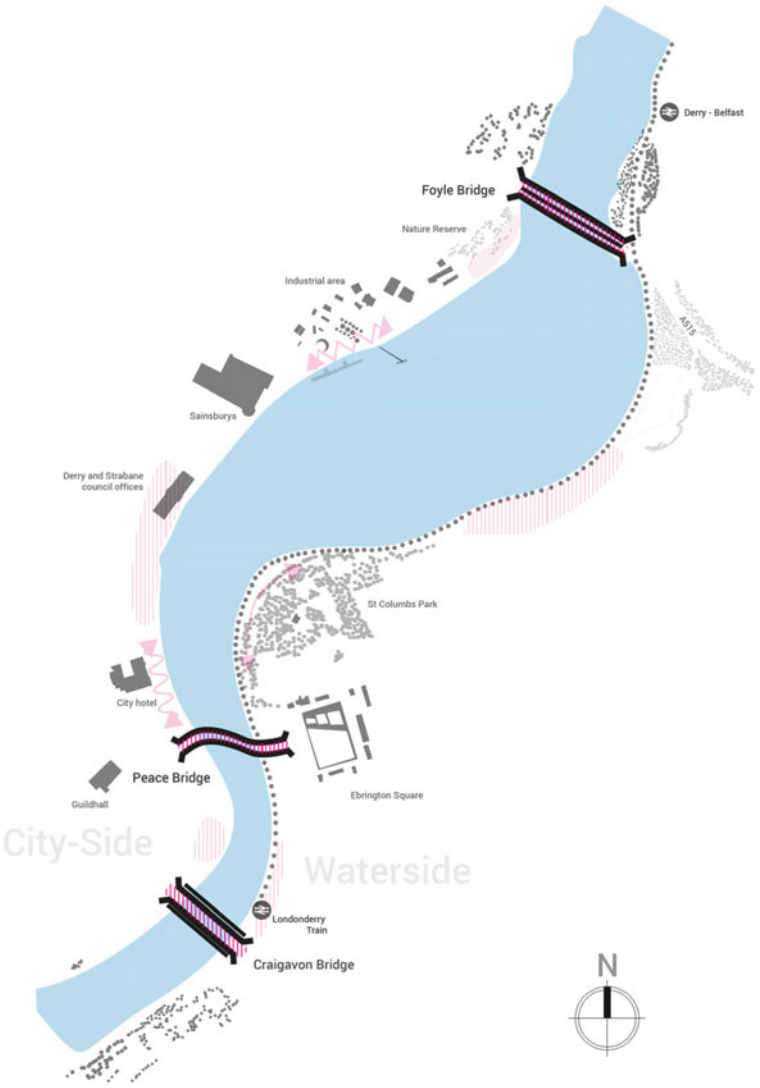

Fig. 1 Map of River Foyle showing the three city bridges

psychological distress. Such identification can potentially influence others to take their own lives at that location (Reisch and Michel 2005).

The River Foyle and its banks currently have a critical reputation for suicidal behaviour. With area associations evolving over generations, it is recognised that it will take time to shift public and community perceptions and as with many other public health initiatives will involve a complex and broad approach that empowers people and communities to collaborate as agents of change. Inclusive innovation

will contribute to creating the right conditions, offering avenues for people-centred engagement in the cities design. A current innovative initiative is the partnership between Public Health Northern Ireland and The Royal College of Art Helen Hamlyn Centre for Design (2016–2019) who have created 'Our Future Foyle' as a research and design initiative that seeks to develop, through community facing inclusive design, social and cultural interventions around arts and leisure that impact the banks and bridges of the River Foyle. This multidisciplinary collaboration brings together; an architect, an information experience designer, an industrial designer with expertise in healthcare, a design anthropologist and public health experts as well as the residents, businesses and community groups within the Derry/Londonderry locality.

3 Our Future Foyle

The team established 'Our Future Foyle' (PHA & HHCD) in early 2016 as the public face for the project with a wider vision of community health and well-being. The brief highlighted how arts, leisure and technology could play a part in interventions with a wider vision of improving well-being and community use of the space for the people of the city.

Establishing the organisation has centred the project as a neutral and empowering voice within the community, allowing the public to have their say on how to improve their riverfront through urban regeneration without reinforcing the stigma of mental health crisis in the area. Public feedback on future public art, disjointed areas and community spaces through to better amenities such as public toilets, cycle lanes and retail spaces have been combined with more in-depth research and engagement with stakeholders. Such public engagement activities have been further informed by focused interviews with experts and individuals about suicidal behaviour. These research insights have informed an iterative design process based on both community and contextual responses and developed towards solutions that are inclusive, enjoyable and that benefit the whole community whilst also acting as a suicide prevention measure.

Our Future Foyle has also had to consider the communities' historical context. Derry/Londonderry caught the world's attention from the late 1960s and through the end of the twentieth century as a city divided by conflict, known as 'the Troubles'. This period resulted in community segregation and divisions that despite considerable progress since the 'Good Friday Agreement' of 1999 still exist today. The legacy of this period continues to impact Northern Ireland's well-being. The World Mental Health Survey Initiative covering 28 countries noted Northern to have the highest rate of post-traumatic disorder amongst those who were not born

during this period (the ceasefire babies) (McLafferty et al. 2016). Such trauma is now considered to be intergenerational and has been identified from Holocaust survivors.

Many of the risk factors for suicide, including history of trauma, unemployment, drugs and alcohol misuse, social isolation and deprivation (O'Reilly et al. 2008), are all prevalent in the city of Derry/Londonderry and it is thought that the higher levels of suicide are also due to post-traumatic stress of the troubles (McLafferty et al. 2016).

Further consideration needs to address the premeditation of suicide, which has been noted to fall into two categories: planned and impulsive. Planned suicides maybe considered over a period of months, weeks or days. In contrast, impulsive suicides may have been considered for less than five minutes (Anderson 2008). Considering incidents on the River Foyle, it is noted that those who have planned their suicide are most likely to have entered the water from the Foyle Bridge, the highest point to the river (Fig. 2). Indications of such planning include its car accessibility as well as relatively quiet periods where visits can be undisturbed. The Foyle Bridge's height also contributes to a high 'completion' rate and to date, only two people are known to have survived a fall from this bridge. In contrast, impulsive suicides are more likely to have entered the river from the banks or lower Peace and Craigavon bridges. The accessibility of the lower bridges and riverbanks from the town centre, coupled with the close proximity to venues selling alcohol, presents a greater opportunity for impulsive suicides.

Combined consideration of these geographical, social and historical factors have been crucial in building co-design relationships with Derry/Londonderry communities and addressing how the project is presented to the community and how consultation will engage.

Fig. 2 The Foyle bridge (Our Future Foyle 2016)

4 The Tale of the Whale

In November 1977, the front page of *The Derry Journal* announced 'Huge whale in the Foyle' and reported that to the bafflement of marine experts an orca (killer whale) had swum up the River Foyle. The whale was given the name 'Dopey Dick', and crowds congregated around the river to see the visitor. Dopey would subsequently enter into Derry/Londonderry folklore. The timing of the whale's visit at the height of 'the Troubles' meant that many children were taken down to the river to witness this event, and Dopey became a neutral visitor in the predominately divided community.

Prior to the research starting, Dopey Dick had again made the front pages of both *Derry Journal* and the *Guardian* with a report that he (although rumour had it he was really a she) was still alive and living off the coast of Scotland—although the 1 April news date might prove difficult to verify. The research team saw the power of this story, especially its occurrence during this specific period of the city's history, as well as its possible transgenerational appeal and opportunities for engagement with older people who remembered Dopey's visit, and younger people, especially children who might enjoy the story of the whale in their river. During a stakeholder workshop, it became apparent that the team's planned community consultation may have to take place 'over here and over there' due to each community's preference for specific spaces of the city. This would effectively double the resourcing of the engagement process. On reviewing the activities and information gathered at the workshop, the team's architect suggested building a specific 'neutral' structure in which to hold engagement activities, and that this structure could take the form of a whale (Fig. 3).

Construction of the whale was to be wholly community focused. The whale's bones were cut by community FabLab, whilst the whale's skin would draw from the cities historical industry of shirt making and was created by material donated by *Smyth & Gibson*—the last shirt makers in the city. Through its toy-like design, the space aimed to attract both children and adults, into inclusive research activities.

During the construction of the whale, the researchers carried out further consultations within the community through a series of workshops that involved 50 people. By annotating scale maps of the area around the river, the participants recorded spaces they thought were negative and positive, as well as putting forward ideas and hopes for the future of the river. The information gathered in these workshops was then assessed and cross-referenced to see if the identified areas reflected wider findings from previous community consultations. It was found that information correlated to wider consultations and pinpointed areas of concern that were shared across ages and cultural heritage. Predominately, negative areas were the area of the riverside path to the south of the river; the Craigavon and Foyle

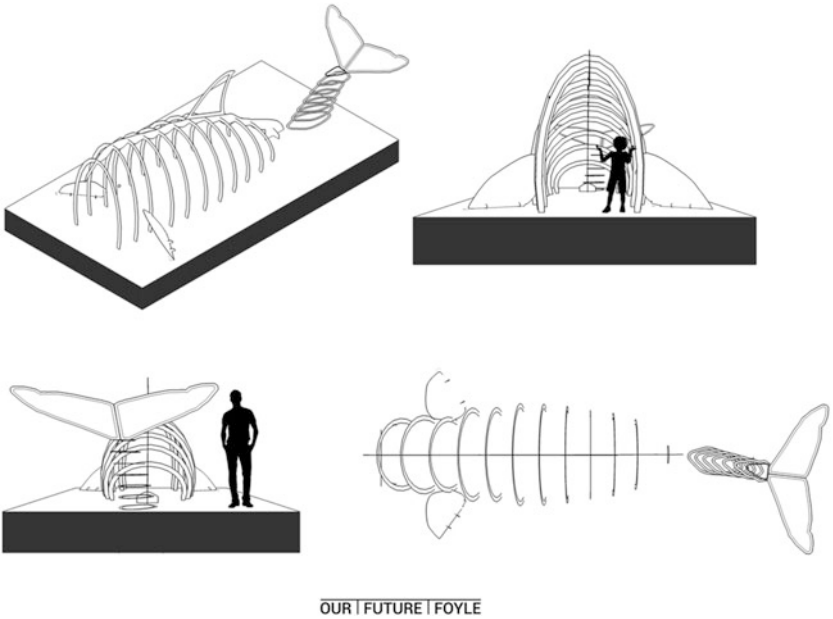

Fig. 3 Outline of whale structure (Alwani; Our Future Foyle 2016)

bridges were also highlighted as negative areas with concerns raised on low lighting, high incidences of anti-social behaviour and less human activity/flow. Positive areas identified included the Peace Bridge and the cafes that had been located close to the river.

5 Extending Inclusive Consultations Through Events

The design and construction of the whale structure presented an opportunity to create a community built neutral space for public engagement and consultation in Our Future Foyle project. Further consultation with research partners identified that a key place for the whale structure would be on the bank of the River Foyle for the cities Maritime Festival. This key event in Derry/Londonderry's calendar has the city as host port for the Clipper round the world race. The Clipper 9-day festival drew an estimated 163,000 people. The whale structure—now formally called Dopey—was on site for 2 days and became the Our Future Foyle research space open to the public. Approximately, 1250 people came to the space and one in five engaged with the consultation through commenting on postcards that were then displayed inside Dopey. Sticker boards were also used for people to vote on various

ideas and hopes previously emerging from the workshops. Children and young people were encouraged to decorate Dopey's skin with pictures and comments highlighting their hopes and aspirations for the River Foyle.

Derry/Londonderry is also known locally as 'LegenDerry' and this status is reflected in the cities world-renowned status for hosting Halloween celebrations. Dopey would return this time as the 'Ghost of Dopey Dick' and set up in the city centre for 4 days over the Halloween weekend. During this event, an estimated 3,000 people visited the research space, and consultations were extended to include video interviews and recorded 'voxpops' of people's thoughts about the river and the opportunities it may present. During the Halloween event, the space also became a central point for community activities and performances including a choir, poetry recitals (Fig. 4) and a music performance.

In the evening, Dopey's interior became a pop-up cinema showing clips from number of water-themed horror films. The weekend's events around and inside Dopey culminated in the taking down and reconstruction of the structure onto a barge. Working in collaboration with Loughs and River's Agencies Dopey was floated down the river during the cities Halloween costume parade and closing firework display (Fig. 5), drawing an estimated crowd of 30,000 people, and featured on local BBC news.

It should be noted that the consultations and activities did not directly discuss the issue of suicide. Participants did comment on incidents and the area's association with suicide behaviour but it was decided that this would not directly be addressed during these public engagements, so that the tone of the event remained positive

Fig. 4 Dopey as community performance space (Our Future Foyle 2016)

Fig. 5 'Dopey Dick' on the river for Halloween celebrations (Gavin Patton 2016)

and highlighted opportunities for future development around the River Foyle. The key question asked at these events was 'what do you want your riverfront to become?'

By focusing on key events in the cities' calendar, the research engaged over 4000 individuals using a variety of inclusive methods. Participation of the research and the Our Future Foyle initiative at these events was designed to engage with ideas formulated at earlier workshops, gather new ideas, gain feedback and increase the presence of the project.

Our Future Foyle events have continued with a pop-up cinema. The research team continues to plan future events as a key method to engage with the community and gather citywide insights from those who attend. These events also help to showcase the design work to as wider audience as possible. Centred around and on the river, the events contribute to tackling the stigma of the area and suggest innovative uses for the space extending inclusive engagement with communities that may not visit the riverfront.

6 Design Proposals

From the extensive engagement with the community, it was clear that a holistic approach to designing interventions for improved well-being would be required, rather than a single physical intervention. The engagement showed the best way to achieve a positive, lasting impact would be to incorporate physical, behavioural, environmental, social and digital interventions. As a result, five design proposals are currently being developed as direct outcomes from these event-based public engagements and design research activities. These social and cultural interventions address suicidal behaviour on the Foyle whilst positively impacting on wider

physical health, well-being, education, tourism and community-specific agenda. As with all Inclusive Design projects, they are created through co-design, with the Derry/Londonderry community regularly consulted throughout the design process. They comprise the following:

- *Foyle Reeds*: a non-imprisoning prevention barrier over the Foyle Bridge and comprising the largest public art sculpture in Northern Ireland. Its aim is to act as an effective suicide prevention installation whilst changing the perception of the bridge to a positive icon with a sense of community ownership (Fig. 6).
- *Foyle Bubbles*: a series of portable satellite spaces set along the river bank, reconnecting disjointed spaces and providing navigational points, to be facilitated by existing organisations and individuals from community, arts and commercial sectors. Hosts of the bubbles will undertake mental health training and offer educational alternatives acting as a community response to the river without clinical stigma.
- *Foyle Experience*: reducing suicides through sensory means. These 'soft' interventions focus on reducing suicide attempts from the Craigavon and Peace bridges. This intervention explores deploying a series of sensory objects that influence how design can affect social perception and cognitive behaviours in a place.
- *Foyle Connect*: a media campaign looking at suicide prevention. By improving public awareness of identifying suicidal behaviour within the home, workplace and community, individuals may feel supported to discuss suicide with potentially vulnerable individuals. This intervention aims to support people before a potential point of crisis at the riverfront.
- *Foyle Digital*: Digital Platform. The creation of a digital platform that promotes community and tourism use along the riverfront; through publicising events, information and facts along the river, the platform acts as a way finding aid with elements of gamification and a discussion platform.

Fig. 6 Proposed 'Foyle Reeds' light installation on the Foyle Bridge showing daily and special event adaptation (Our Future Foyle 2017)

All five of these design proposals directly involve the communities of Derry/Londonderry in their development, and as much as feasibly possible, the building and delivery of the proposals, ensuring a community-led initiative that can proudly announce that it was conceived, built and delivered in the city for the city.

7 Conclusions

Our Future Foyle incorporates elements of inclusive architectural, information, health service and experience design to explore how a key area of a city may develop new opportunities, whilst tackling negative associations with a specific public space. The project's principle aim is to address the issue of suicide in public, but its focus explores how a space may be reconceptualised as an area associated with life-affirming activities and well-being. The design of the whale structure based on a historical occurrence and local memory generated a neutral space in which a still divided community could visit and participate in the project.

A crucial element of this design work has been to engage with the community and understand the issues of the space and city. Both design researchers Alwani and Raby have attended and completed initial and advanced suicide awareness training. As the research has developed and the realisation of design briefs materialises, it has become necessary in both time and budget for one of the researchers to spend extended periods in the city. This gives the design researcher time to build on community and stakeholder networks and immerse themselves in the day-to-day happenings of the communities creating a deeper understanding of what may or may not be accepted by this specific UK population. Such in-depth design ethnography can be seen to be essential to understand a space, a place and the people who inhabit it, and therefore begin to address directly the issue of suicide in public space and contribute to creating improved health and well-being within the city.

The design of the whale pushed the boundaries of design provocations as an Inclusive Design tool to engage participants, to an architectural scale, enabling the participation of the entire city in the redesign of its public space. The findings from this develop Inclusive Design as a tool, from one that has traditionally worked with small, typically excluded groups to open the potential of working with entire populations. The design proposals are specifically focused on social and cultural outcomes that aim to reach all members of the community. The research space of the whale generated cross-community and transgenerational outreach, enabling the design team to focus on well-being outcomes that may benefit the whole community. The design proposals focus on greater sensitivity and improved place making that also acts, in this specific case, as suicide prevention measures.

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The Effect of Age and Gender on Task Performance in the Automobile

L. Skrypchuk, A. Mouzakitis, P. M. Langdon and P. J. Clarkson

Abstract The automobile is becoming more complex as vehicle technologies advance. As a result, driver awareness of internal and external aspects of the environment will influence performance for a range of activities. Inclusivity is an important aspect of vehicle design, especially as autonomous driving functionality increases. This paper examines how users of differing gender and age perform within the vehicle. A simulator study was carried out to assess performance on a range of tasks, whilst driving under different driving conditions. The results show that differences exist between males and females, and older and younger operators for a range of driving and non-driving measures. Older operators generated higher steering wheel variation than younger drivers in driving-only conditions, whilst older and female operators require more button presses and glances away from the road than younger and male operators. The implications relating to in-vehicle interface design are discussed.

1 Introduction

There are many aspects of the automobile that are changing rapidly, such as alternative power sources (Zapata and Nieuwenhuis 2010) and autonomous driving (Luettel et al. 2012). These are aimed at reducing the impact of large global issues such as CO2 emissions and vehicle safety. As such, rapid changes are also being

L. Skrypchuk (✉) · A. Mouzakitis
Jaguar Land Rover Research, Coventry, UK
e-mail: LSKRYPCH@jaguarlandrover.com

A. Mouzakitis
e-mail: AMOUZAK1@jaguarlandrover.com

P. M. Langdon · P. J. Clarkson
Cambridge Engineering Design Centre, University of Cambridge, Cambridge, UK
e-mail: pml24@eng.cam.ac.uk

P. J. Clarkson
e-mail: pjc10@eng.cam.ac.uk

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