Institution: University of Northumbria at Newcastle

Unit of Assessment: 13 (Architecture, Built Environment and Planning)

Title of case study: Sea Hero Quest: Citizen Science Gaming as a Catalyst for Change in Dementia Awareness and Charity-sector fund-raising practice

Period when the underpinning research was undertaken: 2010 – 2019

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Ruth Conroy Dalton	Professor	01/09/2010 – 01/11/2019

Period when the claimed impact occurred: May 2016 – July 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Dementia is a significant health problem affecting approximately 47,000,000 people worldwide. Despite its prevalence, Dementia remains poorly understood; thus, there is no cure. Research conducted at Northumbria University by Professor Dalton on spatial navigation and cognition was fundamental to the development of an interactive game, Sea Hero Quest (SHQ), which generated user-data on navigation abilities for use in dementia research. Since 2016, approximately 4,300,000 users worldwide played SHQ, generating extensive data and boosting public awareness of dementia, contributing to a 38% rise in charitable donations to Alzheimer's Research UK (ARUK), from GBP21,800,000 to GBP30,500,000. This success led ARUK to build a gaming-hub as a revenue generator and inspired an industry-wide shift to greater collaboration between charities and game developers.

2. Underpinning research (indicative maximum 500 words)

The ability of humans to navigate their way around (wayfinding) is widely acknowledged to decline with age; however, the reasons for this are not well understood [**R1**, **R2**]. Professor Dalton's mixed-methods research, utilising a range of methods including eye-tracking, cognitive testing, and analysis of quantitative and qualitative survey data [**R2**, **R3**], addresses this lack and reveals key insights into variances in wayfinding behaviour between young and old populations such as systematic differences in attention-control and landmark observation [**R2**]. It also proves the benefit of utilising virtual reality (VR) as a research tool by demonstrating that there are few statistically significant differences between how participants respond to real and virtual environments [**R3**-**R6**]. These findings have led Dalton and colleagues (from Bournemouth, UCL, UEA, and other EU-based institutions) to advocate for the use of VR as a diagnostic tool for identifying wayfinding issues within vulnerable populations, particularly those believed to have early-stage dementia (a group of diseases and conditions characterised by a decline in memory, language, problem-solving and other thinking skills) [**R3**-**R6**].

Recognition of Dalton's ability to create, and understand human navigation through, virtual environments led to her being approached to join a multidisciplinary, cross-institutional team (comprising experts from UCL, Cambridge, ETH Zürich, and Alzheimer's Research UK (ARUK)), and two global communication companies (Deutsche Telekom and Saatchi & Saatchi) working to develop Sea Hero Quest (SHQ), a mobile game where anyone can help fight dementia [**R7**]. Affecting over 47,000,000 people worldwide (135,000,000 by 2050); it is becoming one of the greatest global medical challenges. SHQ is the world's first mobile game seeking to help scientists improve understanding of dementia [**R7**]. SHQ is designed to measure human spatial navigation ability and processing by asking the player to complete two types of task: wayfinding

(through a range of elaborate tasks including map interpretation and planning/memorising/revising a multi-stop route) and path integration (through a more basic navigation task requiring working memory processes) [**R6**]. SHQ provides controllable, sensitive, safe, and low-cost digital cognitive assessment for individuals known to be, or suspected of, living with dementia [**R5**]. Since its official launch in 2016, SHQ has been played by approximately 4,300,000 users, generating extensive data.

Dalton's key contribution to the development of SHQ was her role in the creation of the overall 'framework' for the design of the 75 game levels (regarding level layout and characteristics, e.g., landmarks). Dalton's prior research in spatial navigation and VR meant she was uniquely placed to support the development of game levels, a process she achieved using a 'reverse-engineering intelligibility' approach (a strategy opposing traditional architectural methods which seeks to make spaces user-friendly and navigable), to ensure each level gradually increased in complexity from very simple through to extremely challenging. The structure of SHQ means it can identify anomalies in player wayfinding behaviour, a well-known sign of early-stage dementia, much more rapidly than standard tests [**R7**].

3. References to the research (indicative maximum of six references)

R1. Ruth Conroy Dalton, Hölscher, C., and Montello, D. R. (**2019**) 'Wayfinding as a Social Activity' *Frontiers in Psychology* **10**(142): 1-14 https://doi.org/10.3389/fpsyg.2019.00142

R2. Grzeschik, R., **Ruth Conroy Dalton**, Innes, A., Shanker, S., and Wiener, J. (**2019**) 'The Contribution of Visual Attention and Declining Verbal Memory Abilities to Age-related Route Learning Deficits' *Cognition* **187**: 50-61 https://doi.org/10.1016/j.cognition.2019.02.012

R3. Kuliga, S. F., Thrash, T., **Ruth Conroy Dalton**, and Hölscher, C. (**2015**) 'Virtual Reality as an Empirical Research Tool - Exploring User Experience in a Real Building and a Corresponding Virtual Model' *Computers, Environment and Urban Systems* **54**: 363-375 https://doi.org/10.1016/j.compenvurbsys.2015.09.006

R4. Ruth Conroy Dalton, Hölscher, C., and Spiers, H. 'Navigating Complex Buildings: Cognition, Neuroscience and Architectural Design' *Studying Visual and Spatial Reasoning for Design Creativity* Gero, J. (ed) 3-22 (London: Springer, **2015**) Available on request

R5. Coutrot, A., Schmidt, S., Pittman, J., Hong, L., Wiener, J. M., Hölscher, C., **Ruth Conroy Dalton**, Hornberger, M., and Spiers, H. J. (**2019**) 'Virtual navigation tested on a mobile app is predictive of real-world navigation performance' *PLoS ONE* **14**(3): 1-15: e0213272 https://doi.org/10.1371/journal.pone.0213272

R6. Coutrot, A., Silva, R., Manley, E., De Cothi, W., Sami, S., Bohbot, V. D., Wiener, J. M., Hölscher, C., **Ruth Conroy Dalton**, Hornberger, M., and Spiers, H. J. (**2018**) 'Global determinants of navigation ability' *Current Biology* **28**(17): 2861-2866 https://doi.org/10.1016/j.cub.2018.06.009

R7. Hyde, M., Scott-Slade, M., Scott-Slade, H., Hornberger, M., Spiers, H., **Ruth Conroy Dalton**, Hölscher, C., Wiener, J., and Bohbot, V. (**3 May 2016**) *Sea Hero Quest: The World's first mobile game where anyone can help scientists fight dementia* https://glitchers.com/project/sea-hero-quest/

4. Details of the impact (indicative maximum 750 words)

The impact arising from SHQ has six main components, building from the work with Alzheimer's Research UK (ARUK), interlinked and cyclical in nature, summarised in figure 1 and explored in detail below:

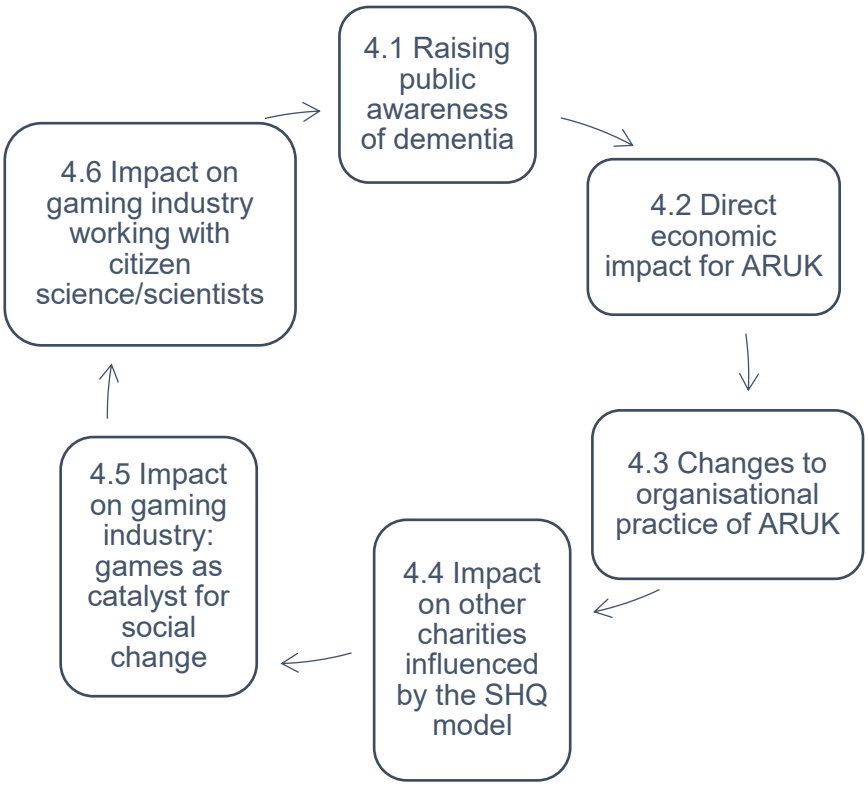

Figure 1: Impact arising from Sea Hero Quest (SHQ) mobile game

4.1 Raising public awareness of dementia

SHQ has received widespread media coverage (EUR30,000,000 media value – GBP23,000,000 in May 2016) and was showcased to the United Nations in 2016. In the days after release in 2016, it became the most downloaded app in the world. The total estimated audience reach for SHQ media coverage was 50,434,817 people in the UK [**E1**]. Renowned YouTuber, 'PewDiePie', promoted its launch, playing SHQ on his YouTube channel and personally donated USD50,000 (GBP40,000 May 2016) to ARUK [**E2**]. Deutsche Telekom reported there were 4,300,000 downloads of the SHQ app [**E3**]. This resulted in widespread awareness-raising for dementia contributing directly to the success of the game in helping develop a diagnostic tool from the resultant user-generated data [**E2**]. SHQ was played for a cumulative 116 years by people across the globe, resulting in an equivalent 176 centuries of dementia research-data making SHQ the largest dementia study, as well as the largest navigational study, in history [**E3**].

4.2 Direct economic impact for ARUK

Tim Parry, Director of Communications, Brand and Partnerships, ARUK, emphasised that SHQ '*helped engage huge numbers of supporters and opened the door to new partnerships and innovative relationships for the charity*' and '*[SHQ] certainly contributed to the overall growth and success of the organisation*' [**E2**]. This support saw a rise in donation income of 38% after the game was released to GBP30,500,000 and a rise in voluntary donations of 44%, 11 times the average growth across the sector [**E2**]. As Parry also observed, '*ARUK is growing at far beyond the typical sector rate, and we attribute much of this to our creative communications and engagement work, of which Sea Hero Quest was a critical component*' [**E2**].

4.3 Changes to organisational practice of ARUK

As ARUK attracted more supporters it was able to fund more research on dementia. Due to SHQ's success, ARUK undertook a significant policy change for garnering public support and donations, '*directly building on our work on Sea Hero Quest…we are now undertaking a new focus on the games sector to facilitate further public engagement and support of dementia research*' [**E2**]. ARUK established a Gaming Hub – a new fundraising tool that enables charity

campaigns and individuals to host online gaming events to raise money - as a core part of its donations model for raising finance and continued to develop this pioneering part of their business model [**E2**].

4.4 Impact on other charities influenced by the SHQ model

Due to SHQ, Tim Parry celebrated ARUK becoming an exemplar of pioneering collaborations and being '*named one of the launchpad charities for JustGiving's new UK promotion of "gaming for good", making [ARUK] an example in the sector of how gaming and charitable support can be united for positive social benefits*' [**E2**]. In 2017 donations to UK charities fell by 4.2%; however, online-giving rose 5.5% indicating its growing importance to third sector business models [**E4**], driving a shift in sector-wide practice towards digital revenue streams. *Third Sector*, the UK's leading publication for the voluntary/not-for-profit sector, cited SHQ as an example that '*has used gaming to advance its cause*' for other charities to follow, highlighting leading charities, *Shelte*r, *Macmillan*, and *JustGiving*, as new entrants to collaborative partnerships with game developers to raise funds and awareness [**E5**, p4]. A survey of national charities in 2019 and 2020 found that due to SHQ '*more charities in the future will be inspired by your example to use gaming as a means of raising money*' [**E6**]. *Autistica*, the UK's leading autism research charity, stated that it is '*paramount that the 3rd sector connects in authentic ways to the games sector*' [**E6**, p16].

4.5 Impact on the gaming industry: games as a catalyst for social change

SHQ was one of the first games nominated for the 2018 British Academy Games Awards, in their inaugural category 'Game Beyond Entertainment' for games which '*deliver a transformational experience beyond pure entertainment*' [**E7**, p1-2]. At the 2018 Webby Awards, it won the award for 'Social Impact' [**E7**, p1] demonstrating how SHQ had influenced the gaming industry, showing how games could be a catalyst for social good. *Glitchers Ltd*., SHQ's game-developers stated, '*Sea Hero Quest has affected the industry as a whole…[it] is beginning to recognise the positive effects of gaming and Sea Hero Quest has helped shift these perceptions as it is proof that this model can work*' [**E8**]. Dalton was invited to judge the 2019 Virtual Reality Awards, selected alongside industry leaders, signalling her position as a key contributor to innovations in the field and the role of SHQ as best practice exemplar [**E7**, p5].

4.6 Impact on the gaming industry working with citizen science/scientists

Science writer and expert in citizen science gaming (collaborative ventures where the public and scientists collaborate through unique tools to gather and generate data) Dara Mohammadi, observed, '*Sea Hero Quest was a landmark in citizen science games and has been an inspiration for other games, and the gaming industry as a whole*' [**E9**]. For Claire Baert, Citizen Science Gaming expert, the *'gaming industry sector has responded the emergence and success of these gaming/research collaborations, with SeaHero Quest as a high-profile and very influential example, to shift practice towards developing more of these games as policy.*' [**E10**].

5. Sources to corroborate the impact (indicative maximum of 10 references)

Ref.	Source of corroboration	Link to claimed impact
E1	Coverage and engagement statistics compiled by Freuds and Proud-Robinson, two communications and public relations companies	Raising public awareness of dementia
E2	Testimonial - Timothy Parry, Director of Communications, Brands, and Partnerships, Alzheimer's Research UK (ARUK)	Raising public awareness of dementia Direct economic impact for ARUK Changes to organisational practice of ARUK Impact on other charities influenced by the SHQ model

E3	Testimonial - Hans-Christian Schwingen, Chief Brand Officer at Deutsche Telekom AG	Raising public awareness of dementia
E4	The Blackbaud Index *Charitable Giving Report 2018* - includes overall giving data from 9,029 non-profit organisations representing USD31,900,000,000 in total fund-raising in 2018 (GBP23,956,900,000 February2019). The Report also includes online giving data from 5,537 non-profits representing USD2,700,000,000 in online fund-raising in 2018 and is designed to inform fund-raising strategies across the non-profit sector (GBP2,027,700,000 February 2019).	Impact on other charities influenced by the SHQ model
E5	Third Sector is the UK's leading publication for news from the charity and voluntary sector.	Impact on other charities influenced by the SHQ model
E6	Survey data from health and dementia charities	Impact on other charities influenced by the SHQ model
E7	Awards and nominations compilation document. Compiled by Northumbria University from publicly available online sources.	Impact on gaming industry: games as a catalyst for social change Impact on gaming industry working with citizen science/scientists
E8	Testimonial - Hugo and Max Scott-Slade, Directors of Glitchers Ltd., the game company who developed Sea Hero Quest.	Impact on other charities influenced by the SHQ model Impact on gaming industry: games as catalyst for social change Impact on gaming industry working with citizen science/scientists
E9	Testimonial - Dara Mohammadi, independent journalist and science consultant writing on gaming	Impact on gaming industry working with citizen science/scientists
E10	Testimonial - Claire Baert, expert/blogger on citizen science games	Impact on gaming industry working with citizen science/scientists