

Digital technology in museums and heritage sites is generally understood to be screen-based, most recently apps for the visitors' phone. Such digitally augmented visits, however, take away the materiality of the collection and the embodied experience that are key to a deep engagement and appreciation. The emerging Internet of Things allows to seamlessly embed sensors and actuators within objects and spaces: in this way technology disappears giving way to a direct emotional connection with the heritage. While such new visiting experiences can be designed, the question of their effectiveness remained.

This paper discusses a comparative study with 76 participants using an app on a mobile phone, a smart card and a smart replica while visiting an exhibition. The replicas and the cards are both tangible, but the replicas have an aesthetic value the smart cards do not have. Visitors' preferences (collected via a questionnaire) and observed behaviours are analysed in depth.

The study is the first to offer a definitive answer to questions that have been asked for the past 10 years on the distracting effect of mobile devices in museums or the assumptions that younger visitors would prefer technology while older generations would resist it.

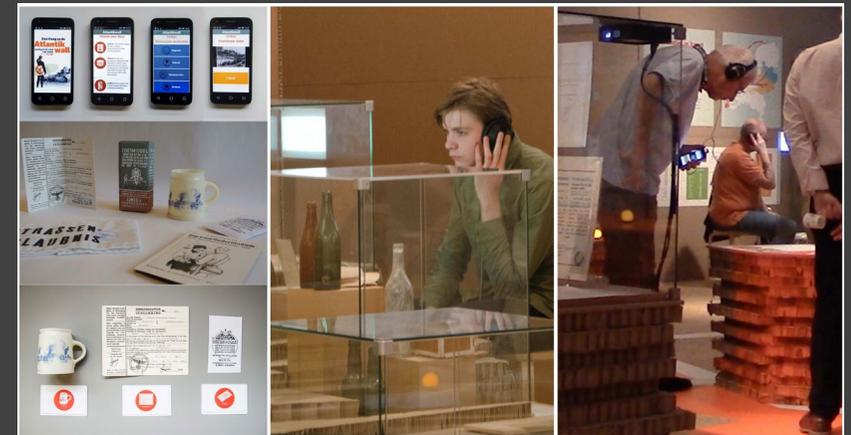
This paper received an Honourable Mention at the ACM CHI Conference on Human-Factors in Computing Systems 2018.

This paper underpins Petrelli's keynote speech "Beyond the Phone: Mobile CH in the age of IoT" at MobileCH - Mobile Cultural Heritage in 2018 at ACM Mobile HCI.

It is also part of Petrelli's keynote speech "From Delivering Facts to Generating Emotions: The Complex Relationship between Museums and Information" given at ACM SIGIR Conference on Human Information Interaction and Retrieval (CHIIR) in 2019.



Above: This video shows the setting of the study: the curator introduces the Atlantic Wall exhibition and the role of the replicas (part of meSch) for exploring multiple digital content available. Three visitors (not involved in the study) offer their opinion on the experience. [Click on image for content](#)



Above: left - the three settings compared (an app on a phone, a set of replicas, a set of cards); center - a young participant using a replicas; right - an mature participant using the phone.

CHI 2018 Honourable Mention

CHI 2018, April 21–26, 2018, Montréal, QC, Canada

Phone vs. Tangible in Museums: A Comparative Study

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ABSTRACT

Despite years of HCI research on digital technology in museums, it is still unclear how different interactions impact on visitors'. A comparative evaluation of smart replicas, phone app and smart cards looked at the personal preferences, behavioural change, and the appeal of mobiles in museums. 76 participants used all three interaction modes and gave their opinions in a questionnaire; participants interaction was also observed. The results show the phone is the most disliked interaction mode while tangible interaction (smart card and replica combined) is the most liked. Preference for the phone favour mobility to the detriment of engagement with the exhibition. Different behaviours when interacting with the phone or the tangibles were observed. The personal visiting style appeared to be only marginally affected by the device. Visitors also expect museums to provide the phones against the current trend of developing apps in a "bring your own device" approach.

Author Keywords

Museum, tangible interaction, mobile phone, comparison.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Much work has been done in HCI on ways in which digital technology could be used in museums, exhibitions and heritage sites to engage visitors. The range of research is broad: apps to deliver information, to deliver music or to play games (e.g. [4][8][11][14]); interactive and embodied experiences (e.g. [7] [36]); and bespoke tangible installations (e.g. [32] [3]). Although applied to the same context, the purpose of these works is very different and so is the response of visitors. These studies combine some form of content delivery (soundscape vs. plain information) with a digital device (bespoke vs. off-the-shelf). The intertwined design makes it difficult to decouple the effect of the content from that of the technology and it is therefore

difficult to draw lessons from across the spectrum of studies in the literature.

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To shed some light on the effect different technological means have on visitors, a comparative evaluation of a phone app vs. a tangible way to control and activate multimedia content in an exhibition was set up. While the content stayed the same, the way in which the content was triggered and delivered changed. We compared an app on a mobile phone against smart cards and smart replicas. The cards and the replicas activate the content in the same way, via tangible manipulation, which is different from finger interaction on the phone (different functionality). The difference between cards and replicas is purely aesthetic: the cards have the sole purpose of activating the content, while the replicas add an aesthetic value to the same NFC mechanisms as the cards. This experiment then allowed us to unpack and better understand the role of both function and aesthetics. In particular, we aimed to answer questions such as: does the means of activating and delivering content impact on the visiting experience? If so, in what way? Are there differences between visitors? What are their expectations? What lessons can be learnt for the design of technology for museum and exhibition? Does aesthetics play a role or is functionality dominating?

A comparative within-subject study was set up and data collected from 76 participants. The context was an exhibition in which smart replicas were used to control the delivery of multimedia content [20]. Participants were observed during the use of the three different modes, i.e. the phone, the card and the replica, and questioned about their like and dislike. In addition, expectations or reservations when a museum offers an app were also investigated.

The paper is organised as follows. Technology to support museum visitors is reviewed firstly, followed by a description of the exhibition. Then the comparative evaluation is discussed with regard to its setting, data collection and analysis. A thorough discussion of the implication for the design of interactive technology for museums concludes the paper.

RELATED WORK

Digital technology has been used in museums since the early 90s [29]. Indeed museums have been considered an ideal place to experiment with the newest technology (e.g. multi-touch tabletops [15]), sometimes trying devices that later failed in the market, e.g. Apple MessagePad [21] or Google Glass [1] [31]. Given this wide range, we limit our

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CHI 2018, April 21–26, 2018, Montréal, QC, Canada

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<https://doi.org/10.1145/3173574.3173686>

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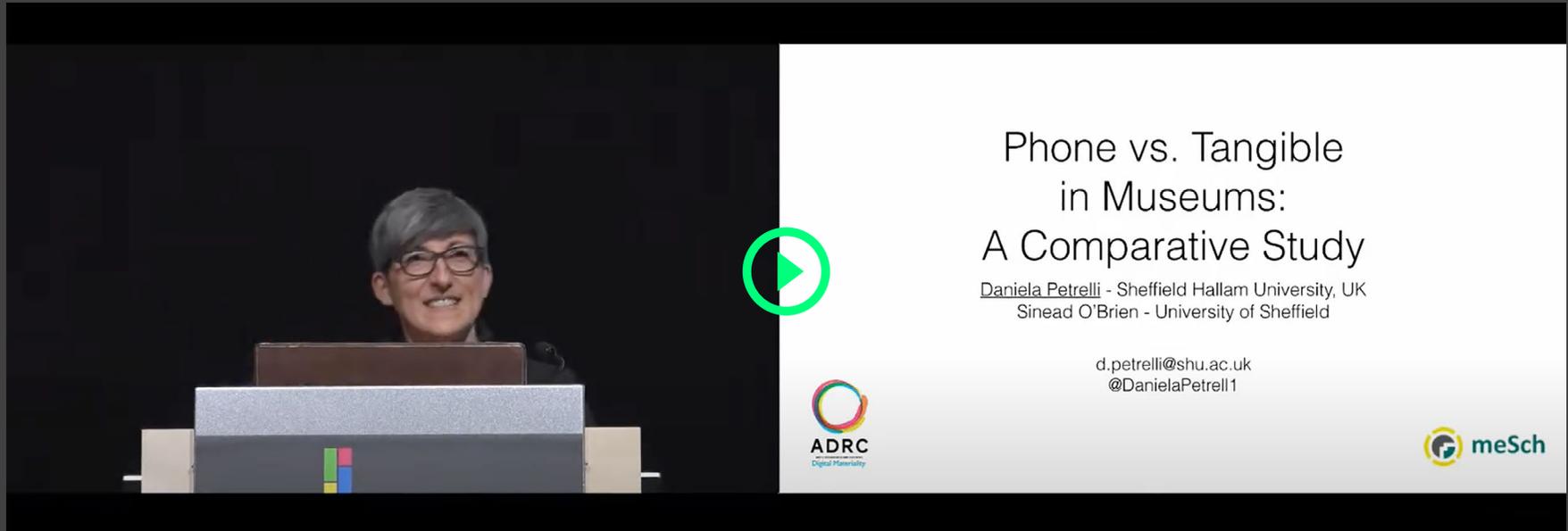
Above: Phone vs. Tangible in Museums: A Comparative Study

<https://dl.acm.org/hallam.idm.oclc.org/doi/pdf/10.1145/3173574.3173686>

The study compared three different modes to control multimedia in a museum exhibition. Data collected included questionnaires and observations. Observed visiting behaviours were coded respect to body posture and their focus of attention. Participants who moved often and shifted their attention often were 'fish' while less mobile and more focused participants were 'ants'. The video shows such different visiting behaviours with the phone and the tangibles (replica or card).



[Click on image for content](#)



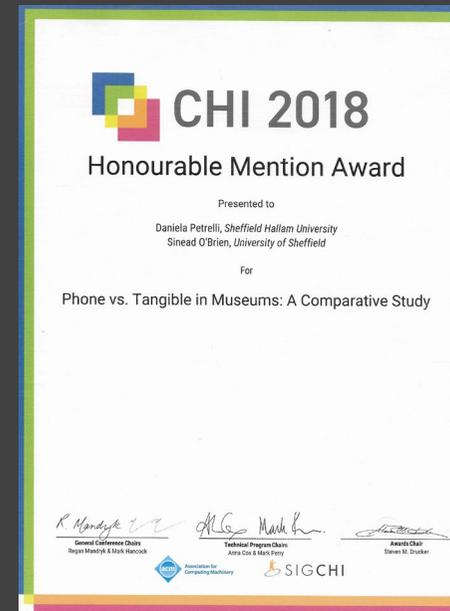
ACM CHI18 presentation
[Click on image for content](#)

The paper was presented at the ACM CHI '18: Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems

The paper received a honourable mention

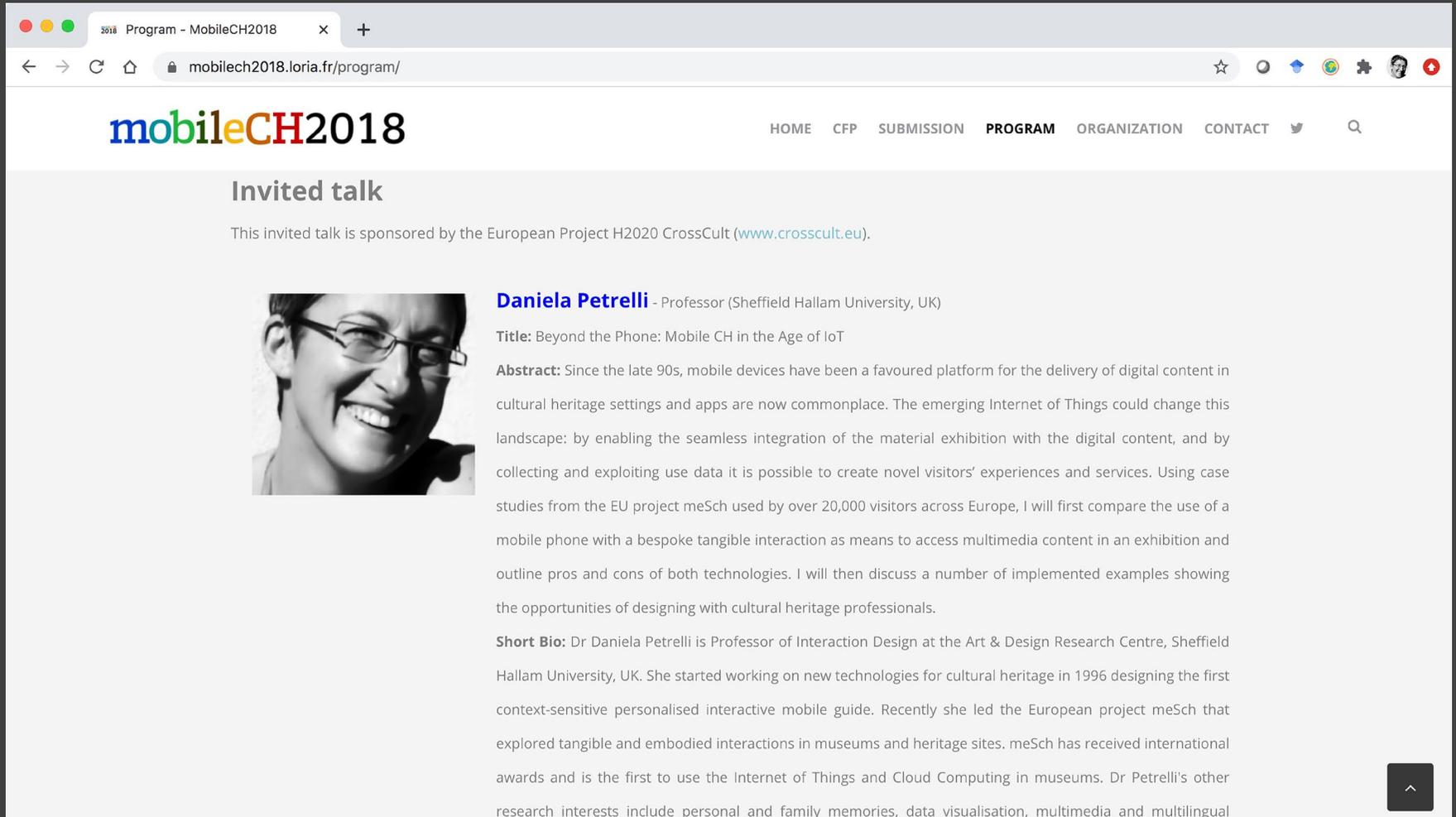
ACM CHI is the world leading conference in the field of human-computer interaction, acceptance rate of 25.7%; top 4% awarded the honourable mention

[View Website](#)



The award given for the paper.

This paper underpins Petrelli's keynote speech "Beyond the Phone: Mobile CH in the age of IoT" at MobileCH - Mobile Cultural Heritage in 2018 at ACM International Conference on Mobile Human Computer Interaction.



The screenshot shows a web browser window with the URL mobilech2018.loria.fr/program/. The page features the "mobileCH2018" logo and a navigation menu with links for HOME, CFP, SUBMISSION, PROGRAM, ORGANIZATION, and CONTACT. The main content area is titled "Invited talk" and includes a sponsorship notice for the European Project H2020 CrossCult (www.crosscult.eu). A portrait of Daniela Petrelli is displayed next to her name and affiliation: Daniela Petrelli - Professor (Sheffield Hallam University, UK). Below her name, the title of her talk is "Beyond the Phone: Mobile CH in the Age of IoT". The abstract text describes the talk's focus on mobile devices, IoT, and tangible interactions in museums. A "Short Bio" section provides background on Dr. Petrelli's research and professional experience.

Invited talk

This invited talk is sponsored by the European Project H2020 CrossCult (www.crosscult.eu).



Daniela Petrelli - Professor (Sheffield Hallam University, UK)

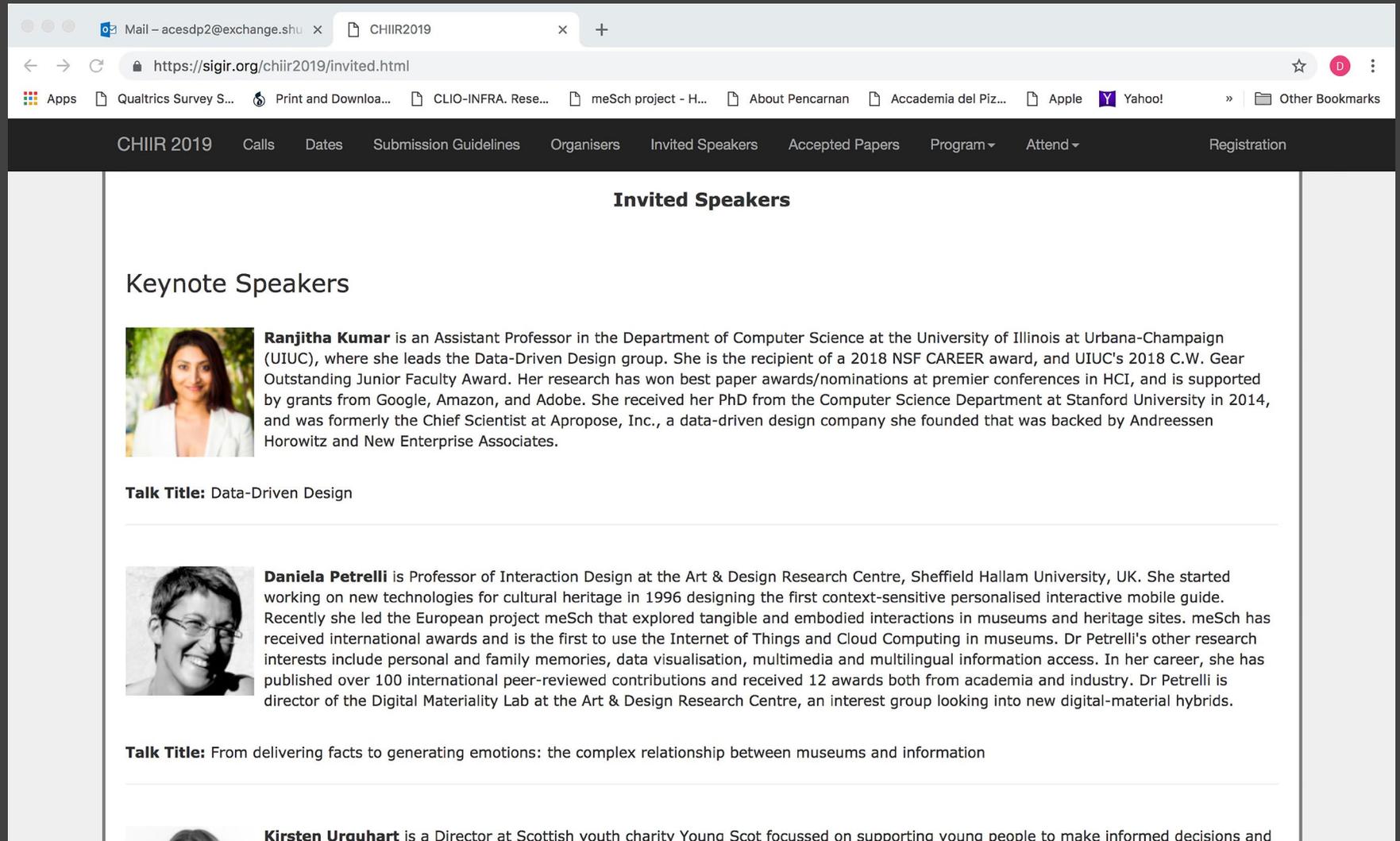
Title: Beyond the Phone: Mobile CH in the Age of IoT

Abstract: Since the late 90s, mobile devices have been a favoured platform for the delivery of digital content in cultural heritage settings and apps are now commonplace. The emerging Internet of Things could change this landscape: by enabling the seamless integration of the material exhibition with the digital content, and by collecting and exploiting use data it is possible to create novel visitors' experiences and services. Using case studies from the EU project meSch used by over 20,000 visitors across Europe, I will first compare the use of a mobile phone with a bespoke tangible interaction as means to access multimedia content in an exhibition and outline pros and cons of both technologies. I will then discuss a number of implemented examples showing the opportunities of designing with cultural heritage professionals.

Short Bio: Dr Daniela Petrelli is Professor of Interaction Design at the Art & Design Research Centre, Sheffield Hallam University, UK. She started working on new technologies for cultural heritage in 1996 designing the first context-sensitive personalised interactive mobile guide. Recently she led the European project meSch that explored tangible and embodied interactions in museums and heritage sites. meSch has received international awards and is the first to use the Internet of Things and Cloud Computing in museums. Dr Petrelli's other research interests include personal and family memories, data visualisation, multimedia and multilingual

Program of Mobile Cultural Heritage – key note.

This output is part of the keynote speech given by Petrelli at ACM SIGIR International Conference on Human Information Interaction and Retrieval (CHIIR) in 2019



The screenshot shows a web browser window with the URL <https://sigir.org/chiir2019/invited.html>. The page title is "Invited Speakers". Under the "Keynote Speakers" section, two speakers are listed:

Ranjitha Kumar is an Assistant Professor in the Department of Computer Science at the University of Illinois at Urbana-Champaign (UIUC), where she leads the Data-Driven Design group. She is the recipient of a 2018 NSF CAREER award, and UIUC's 2018 C.W. Gear Outstanding Junior Faculty Award. Her research has won best paper awards/nominations at premier conferences in HCI, and is supported by grants from Google, Amazon, and Adobe. She received her PhD from the Computer Science Department at Stanford University in 2014, and was formerly the Chief Scientist at Apropose, Inc., a data-driven design company she founded that was backed by Andreessen Horowitz and New Enterprise Associates.

Talk Title: Data-Driven Design

Daniela Petrelli is Professor of Interaction Design at the Art & Design Research Centre, Sheffield Hallam University, UK. She started working on new technologies for cultural heritage in 1996 designing the first context-sensitive personalised interactive mobile guide. Recently she led the European project meSch that explored tangible and embodied interactions in museums and heritage sites. meSch has received international awards and is the first to use the Internet of Things and Cloud Computing in museums. Dr Petrelli's other research interests include personal and family memories, data visualisation, multimedia and multilingual information access. In her career, she has published over 100 international peer-reviewed contributions and received 12 awards both from academia and industry. Dr Petrelli is director of the Digital Materiality Lab at the Art & Design Research Centre, an interest group looking into new digital-material hybrids.

Talk Title: From delivering facts to generating emotions: the complex relationship between museums and information

Kirsten Urquhart is a Director at Scottish youth charity Young Scot focussed on supporting young people to make informed decisions and