An Interdisciplinary Perspective on Health and Wellbeing in the Built Environment

Report on the Bartlett Research Exchange on Health and Wellbeing in the Built Environment

March 2017

Keywords: interdisciplinary research, health, wellbeing, built environment

Summary

The purpose of this report[1] is to summarise the talks presented at the "Bartlett Research Exchange: Health and Wellbeing in the Built Environment" event which took place in February 2017. A gathering of academics and other interested parties came together to hear presentations by scholars from UCL Bartlett School of Architecture (Dr Yeoryia Manolopoulou, Prof Níall Mclaughlin and Dr Kerstin Sailer), UCL Institute of Neurology (Dr Sebastian Crutch), UCL Bartlett School of Environment, Energy and Resources (Prof Michael Davies and Dr Marcella Ucci), UCL Psychology and Language Sciences (Prof Susan Michie and Dr Hugo Spiers) and UCL Department of Civil, Environmental & Geomatic Engineering (Dr Lena Ciric). A current CASA project with the UCL Africa Centre for Health and Population Studies in South Africa was demonstrated at the end of the event by David Concannon (CASA). The event was convened by Professor Laura Vaughan, Vice-Dean Health at the UCL Bartlett Faculty of the Built Environment, with introductory talks by the UCL Vice-Provost Health, Professor David Lomas and UCL Bartlett Dean, Professor Alan Penn.

Much of the research conducted at the Bartlett is undertaken in collaboration with other UCL departments. Some of these studies were presented at the event to illustrate the variety of research that focuses on health and wellbeing. There are of course many other past and current projects that bridge across the two disciplines and a number of other recent studies focus on walkability, urban health, epidemiology, healthcare delivery and obesogenic environments. For example, Dr Andrea Rigon and Dr Alexandre Apsan Frediani from the Bartlett Development Planning Unit (DPU) have recently partnered with the Institute of Geography and Development Studies at Njala University, Sierra Leone to create a globally connected research centre – The Sierra Leone Urban Research Centre (SLURC) in Freetown[2]. The centre aims to generate capacity building as well as research initiatives in cities across Sierra Leone focused on the wellbeing of residents of informal settlements.

[1] The report authors are: Prof Laura Vaughan (UCL Bartlett School of Architecture, Vice-Dean for Health for the Bartlett Faculty of the Built Environment) and Rosica Pachilova, currently PhD in Architecture candidate at the Space Syntax Laboratory, UCL Bartlett School of Architecture.
[2] http://www.slurc.org.

Bartlett Research Exchange: Health and Wellbeing in the Built Environment

The Bartlett Research Exchange (BRE) on health, wellbeing and the built environment took place on 27th February 2017. It involved speakers with expertise in architectural design, social and spatial networks, architecture and building engineering, and urban computation and visualisation. An installation from the Bartlett's Centre for Advanced Spatial Analysis showcasing their work with the UCL Africa Centre for Health and Population Studies in South Africa was on display throughout the event.

Academics based at University College London's Bartlett Faculty of the Built Environment have myriad specialisms, which range from anthropology, architecture and engineering to history, planning and politics. This BRE was set up to showcase the breadth of health-related research currently being undertaken across the Bartlett. It is the faculty's ambition to bring the range of this expertise to bear on the complex subject of health and – given this complexity – to seek opportunities for closer interactions between Bartlett built environment specialists and researcher colleagues working across UCL in the arena of health and wellbeing. Following a summary of the presentations, this report discusses the themes that emerged from the event and in particular, the challenges for interdisciplinary research in this domain.

Theme 1 Designing with and for people with dementia

Dr Yeoryia Manolopoulou and Prof Niall McLaughlin have worked together in architectural practice for a decade. Their expertise includes designing buildings for people with dementia, for which they worked on a project called 'Losing Myself' that explored the interaction between the architect's intention for a building and its subsequent inhabitation. For people with dementia it becomes gradually harder to situate themselves and to navigate their way in the world: two capacities that are central to the experience of architecture. To understand the illness as well as the perceptions and needs of people with dementia, Yeoryia and Niall engaged with neurologists, psychologists, caregivers, patients and their families on multiple occasions. They also explored dementia through paintings produced by patients and observed their everyday activities and movement patterns in the care home. The architects came to the realisation that one of the most important things for patients was to stay independent and be able to care for themselves and this had to be implemented in the design of care homes.

Figure 1 'Losing Myself' installation designed by Dr Yeoryia Manolopoulou and Prof Niall McLaughlin. It represented Ireland at the 15th International Venice Biennale

Inspired by years of research, McLaughlin and Manolopoulou designed an immersive installation that represented Ireland at the 15th International Architecture Exhibition in Venice, Italy in 2016, where they superimposed a dynamic mosaic of continually evolving, overlapping imagery onto the floor plan of an Alzheimer's Respite Centre in Dublin, Ireland. The authors explain that "when architects draw plans, we allow ourselves the privilege of a total view of every space, seen all at once. In contrast, here we have tried to imagine the way in which people with dementia experience the building" (Martin, 2016). The projection created overlapping views of how 16 occupants experience the building during the course of a day, in a 16-minute sequence. The drawings reflected the way in which the human mind constructs intertwined representations of situation and memory. Along with their post-occupancy evaluations of their designed care homes, the architects' research experimentation and conversations have revealed the need to take account of the changing manner of visual perception experienced by people with dementia through the use of 'daisy-chains' of visual prompts, as one example.

Similarly to McLaughlin and Manolopoulou, Prof. Sebastian Crutch studies how the built environment can have an effect on patients with Alzheimer. Professor Crutch is a neuropsychologist at the Dementia Research Centre at the UCL Institute of Neurology. In his presentation he argued that making general conclusions about people with dementia is difficult because the illness has different affects. However, a few of the common symptoms are visual disorder, memory loss and behavioural changes. Sebastian currently leads a four-year Economic and Social Research Council (ESRC) and National Institute for Health Research (NIHR) funded programme.

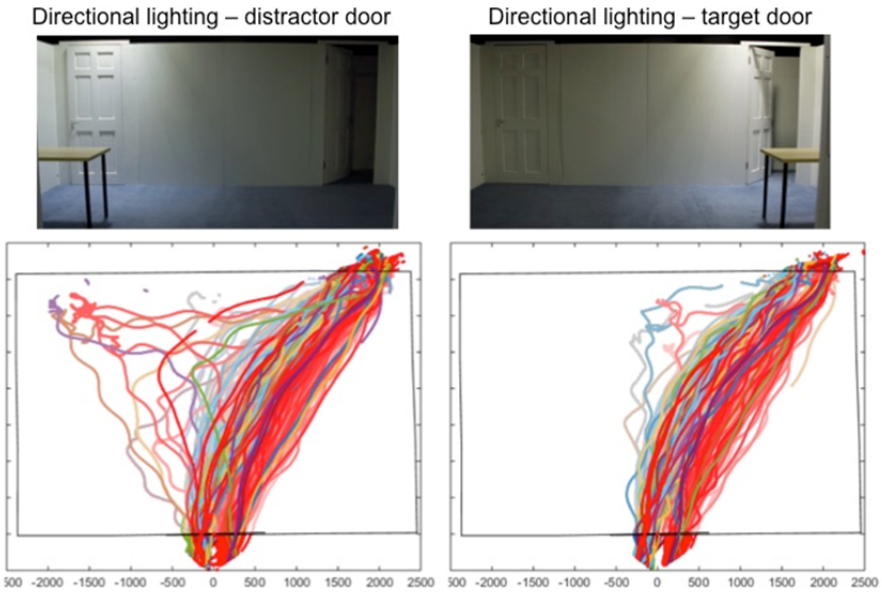

Figure 2 Alzheimer patients walking paths in PAMELA directional lighting experiment

The project aims to improve the understanding of the functional impact of dementia-related visual impairment and will develop home-based interventions in order to improve independence and quality of life both of individuals with dementia and their caregivers. Sebastian and his team are investigating whether visual cues improve navigational ability and whether the cue effects vary across groups. They conducted experiments with Alzheimer patients in the UCL Pedestrian Accessibility and Movement Environment Laboratory (PAMELA), testing how patients walk through space with and without visual and motion cues. Prof. Crutch's research suggested that simple changes such as lighting, or the arrangement of furniture in a room, can make significant changes to the behaviour of people living with dementia. Such an important understanding is a step forward in helping Alzheimer patients to interact more successfully

with their visual environment at home that can have a significant positive impact upon the wellbeing and quality of life of both patients and carers.

Theme 2 The complex relationship between the urban built environment and well-being

Prof Mike Davies has led an extensive programme of research for over a decade collaborating with researchers from health and other disciplines in seeking to understand the complex relationship between the built environment and human well-being. He recently received a special invitation from the Wellcome Trust to submit a £5M project "Complex Urban Systems for Sustainability and Health" (CUSSH) to commence in October 2017, as part of a 'London Partnership on Planetary Health' with the London School of Hygiene and Tropical Medicine and a number of international partners.

Figure 3 The six cities with different social and economic statuses selected as partners for the CUSSH project

Global urbanisation has changed the layout of our cities drastically in the last few decades. Such an impact comes from many environmental and economical changes. With the CUSSH project, Mike and his colleagues aim to offer a solution for building healthier and sustainable environment for human well-being. Six cities with different social and economic statuses were selected for a comparison. For example, the current trend in London and Rennes is for a slow transition to low-carbon vehicles. The municipality of Rennes has already implemented a plan to become a low-carbon city and to lower the negative effects of urbanisation until 2030. However, in Beijing and Nairobi, the situation is drastically different because of growing pollution due to rapid economic development.

The work of the CUSSH team is based on three components: 1) collecting quantitive scientific evidence and data; 2) translation into action, and 3) encouraging wider engagement and capacity development. The project will use already identified problems and desired outcomes to suggest acceptable scenarios and changes in discussion with policy makers and institutions. The desired outcome is to encourage more innovative thinking for building healthier cities.

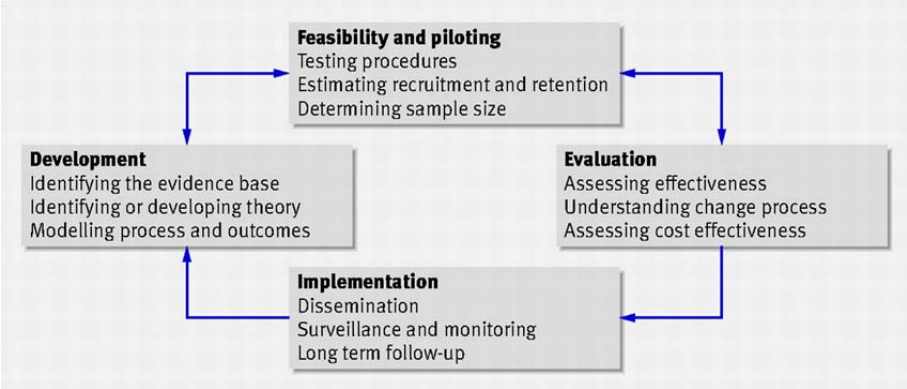

Figure 4. MRC Framework for developing and evaluating complex interventions

Prof Susan Michie from the Centre for Behavioural Change is a co-investigator on the CUSSH project. As a behavioural scientist, she offers a complementary perspective. Part of understanding complex systems is to understand behaviouristic patterns. Human behaviour is complex in itself because it occurs as an interaction between three necessary conditions – capability, motivation and opportunity (Mitchie et al, 2011). If capabilities are in place i.e. one has the required knowledge and skills but has no opportunities or motivation, behavioural change is not going to happen. If one has all the capabilities in the world, but no physical and social opportunities nothing is going to happen. Finally, if one has all the capabilities and opportunities but no motivation, nothing is going to happen.

Alongside complexity, the CUSSH project has a development and implementation phases which are key to the project. According to the MRC Framework for developing and evaluating complex interventions (Craig et al, 2009), these two phases would guarantee the practicability, acceptability and costeffectiveness of the project. Both Mike and Susan advocate for transdisciplinary approach that is vital for the success of the project. This requires not only to learn how to work with each other, but really to understand each other's methods and theories in such a ways so we can begin to generate new knowledge.

Theme 3 Affordances of Spatial Layout for People's Movement and Behaviours

Understanding how the design of hospitals influences movement and work processes of caregivers is as important as understanding the perception and experiences of patients with different illnesses. Such knowledge can potentially help architects to design better buildings and ultimately improve quality of care. Dr Kerstin Sailer's research focuses on this problem. In a recent comparative study of two hospital sites, she aimed to understand the degree to which detailed work activities resembled each other across the two cases and what affordances the spatial layout of the clinics had on the routinized behaviours of busy practitioners. Five corresponding outpatient clinics in each hospital were selected for a comparison. In Hospital A the back- and front-of-house areas were strictly separated while Hospital B was more traditionally structured with a system of corridors that connected waiting areas with exam rooms. Moreover, the clinics in Hospital A were co-located and had a shared work area called the 'Knowledge Centre' while clinics in Hospital B were separated and did not have shared facilities (Sailer et al, 2013).

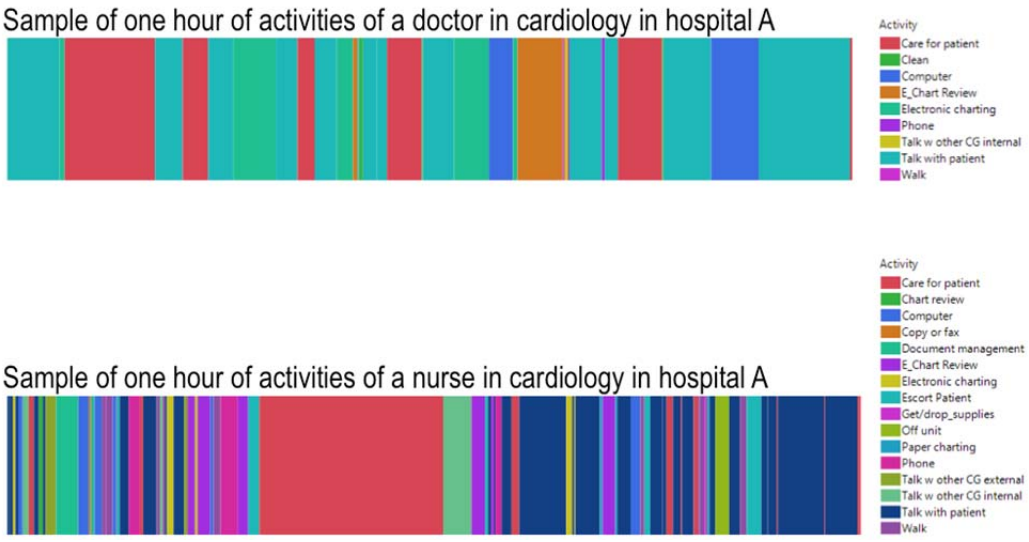

Figure 5. Bar charts showing a one hour sample of activities observed for: a doctor (above) and a nurse (below) in Hospital A, illustrating how care processes differ substantially across roles

The spatial layout of each hospital was analysed with space syntax methods. Space syntax represents the continuous flow of space as a series of linked elements, for instance rooms and corridors in a building are connected by doorways or staircases. The method uses graph-based mathematics to compute the relative

closeness (or, how easy it is to get to all elements from all other elements within a given distance) and betweenness (or, how many routes use that segment within a given distance). These spatial measures are then set against social or behavioural data to consider the correspondence between the layout of a building (or city) and the way it is being used.

Twelve caregivers in each of the five clinics studied were shadowed while conducting their everyday duties. Results indicated that an average communication event between caregivers in Hospital B took almost twice as long as in Hospital A. This can be explained by the spatial analysis of the two hospitals, which found that Hospital A had higher visibility levels than Hospital B meaning that it was a lot easier to find help. This made interaction among caregivers times more efficient than in Hospital B. Care processes differ substantially across roles as well as from clinic to clinic but there was more similarity within hospitals than within speciality. In conclusion, those clinics with highest visibility levels tend to have shorter duration of activities, which pointed towards dynamic work processes supported by the layout of the clinic.

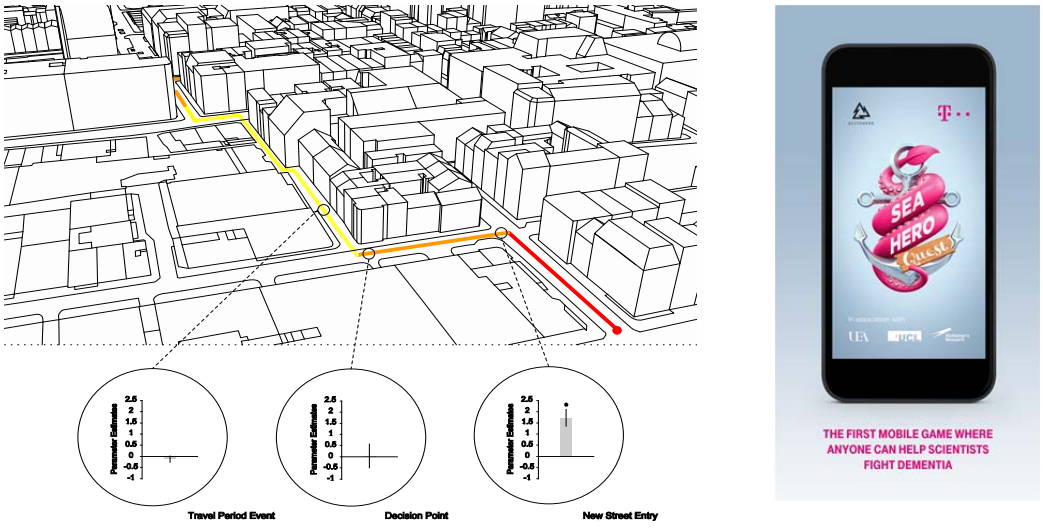

Figure 6. Combining Space Syntax measures with a navigational study in Soho (left) and Sea Hero Quest interface (right)

Dr Hugo Spiers also looks at how people move through the built environment and uses space syntax methods to analyse spatial arrangements, though his research area is different. Hugo is a neuroscientist and he investigates how an individual's brain constructs representations of what they can see in order to navigate around an area. He used the streets of Soho as a case study to investigate how and where decision-making processes took place for people navigating through the area. Having first walked the streets, ten high definition films of different journeys were projected to participants while they were scanned using an MRI. Hugo and his team observed at what points during their virtual walk people's brains reacted differently. They used space syntax analysis to measure the nature of the decision being taken (namely, the spatial characteristics of each decision point). Their results showed that specific areas of the brain are used to support navigation and that these correspond to particular spatial characteristics of the street layout (Javadi et al, 2017).

Other research by Spiers team has involved collaboration with game experts *Glitchers*, the University of East Anglia, and Alzheimer's Research to develop a multi-platform mobile game called Sea Hero Quest[3]. The aim of the project was to diagnose dementia in its early stages and to help contribute to research into treatment for the disease. To date 2.5 million people have played the game, making this the largest dementia study in history. The game is made up of three main tasks: navigating mazes, shooting flares to test players' orientation and chasing creatures to capture photos of them. Players are asked to share their game data with the researchers and to provide background demographics. The researchers are able to analyse the data to track how the brain detects and processes information about routes, for example, how it responds to changes in the number of junctions available along a street. They have found that

[3] http://www.seaheroquest.com

navigational capabilities begin to decline from age 19 onwards and that there are fundamental differences in the spatial navigation strategies between men and women as well as striking differences between nations.

Theme 4 The influence of moisture in buildings on human health and well-being

Dr Marcella Ucci investigates the interactions and tensions between sustainable building design and operation and the needs of occupants in terms of comfort, health and wellbeing. Her latest research focuses on the problem with moisture and mould, which is widespread in the UK and can cause various health problems. Excess moisture in buildings as well as air humidity create mould on building surfaces, leading to asthma and respiratory problems. There is also some evidence that suggests that poorly maintained buildings and the subsequent problems such as mould can lead to mental health illnesses. The range of health issues is quite wide and there is a lack of scientific health-based guidance and thresholds for acceptable levels of contamination. This problem requires an interdisciplinary approach because of the number of critical interrelated research questions, which remain unanswered.

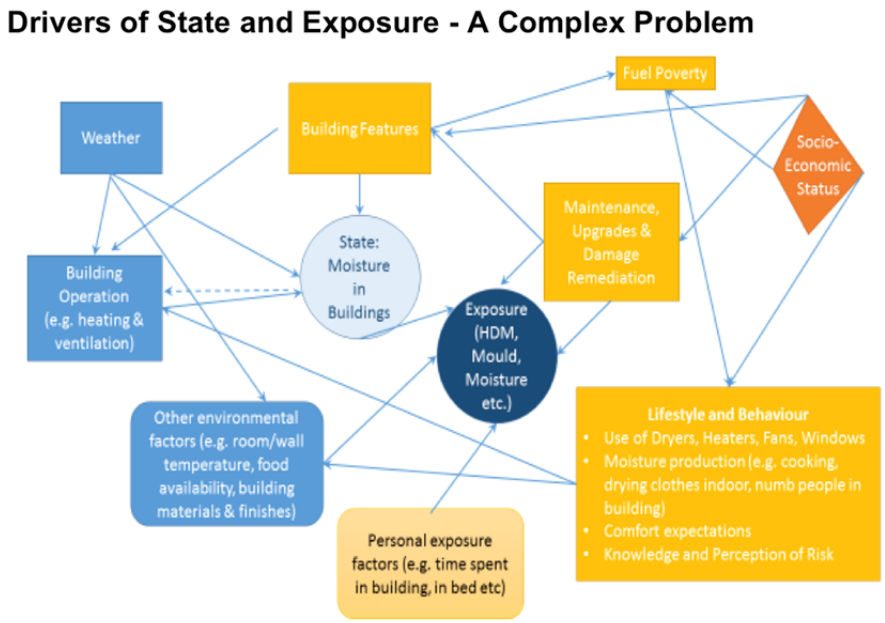

Figure 7 Moisture in buildings as a complex problem

One of the biggest gaps in building research is how to measure exposure to moisture. There is a lot of debate around sampling methods: what to measure, how much, where, when and how often. Many epidemiological studies to date have looked at proxies for exposure, primarily focusing on what is visible. However, mould has a number of biological components and species that are invisible and are therefore much more difficult to detect and measure, especially by a lay surveyor. The English Housing Survey showed that over the last few years there has been a decrease of damp and moisture problems in English houses. However a closer look at the data finds that there is a particular sector of the population which is more likely to be exposed to dampness problems – those in the lowest income group, those who live in most deprived areas, with a disproportionate number of ethnic minorities. Since there are no clear government policy and guidelines on how to prevent dampness and mould, lifestyle choice has been blamed as the cause for mould. However, in many cases, the issue is not lifestyle choice, but because people lack any choice. Housing size and energy costs mean that supposedly straightforward procedures for ventilating and/or heating are insufficient to overcome excess moisture build-up. Similarly, landlords of some types of housing are less likely to maintain their properties to adequate standards. Without clear statutory guidelines and without clear measures of acceptable standards, the result is a complex problem for which only a transdisciplinary approach can achieve a solution.

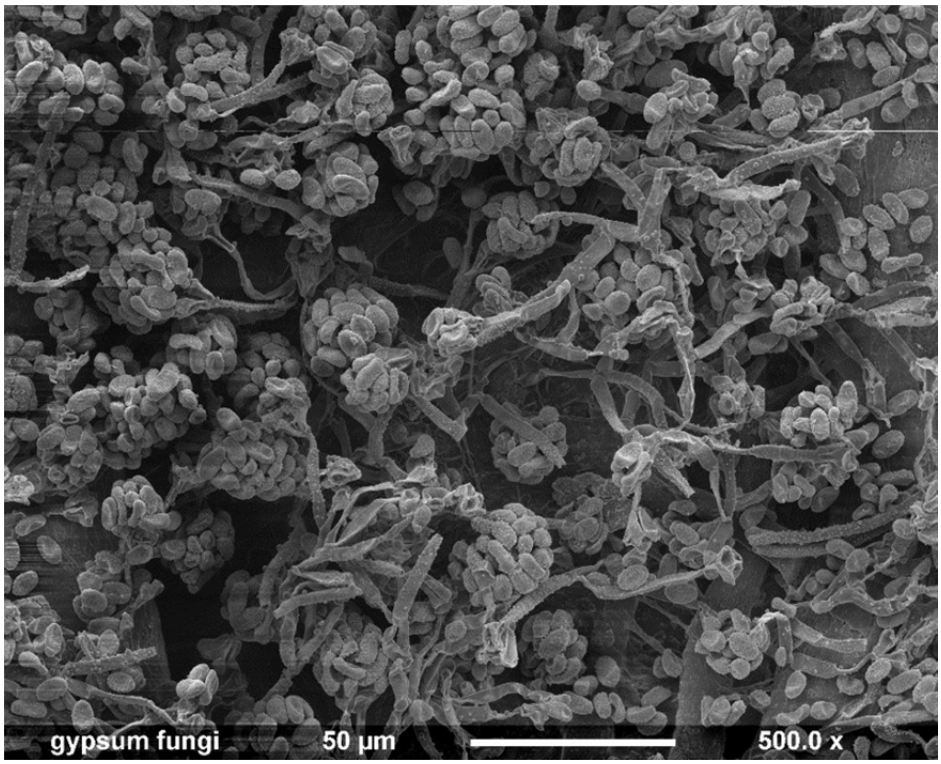

Figure 8 Electronic micrographs of a common mould found in buildings, Stachybotrys chartarum, growing on plasterboard. Photo by Asrah Binti Mohamad, UCL HIRG

Dr Lena Ciric is a microbiologist who works with engineers to investigate engineering solutions that reduce the spread of infectious diseases and improve environmental health. One of the projects that Lena is working on at the moment focuses on mould and how it behaves in different building materials. Mould microorganisms look for any niche or habitat they can exploit, so in the case of dampness in buildings they can exploit various nutrients. They pick up moisture from the air and the surfaces but also use building materials such as cellulose, gypsum, wallpaper as nutrients for growth. There are different types of moulds, some of the them more toxic than others and they are not necessarily visible at first sight.

Lena and her team have been looking into ways to kill mould in various building materials, finding that the only everyday detergent that works is bleach. Unfortunately, the use of such a chemical is toxic in itself. At present, the best advice is to try to prevent mould in the first place by improving heating and ventilation. This is not always easy to perform as there are often costs associated with these implementations and more interdisciplinary research is required to find a better and cost-effective solution to the problem.

Conclusions

Several thoughts emerged from the presentations and the follow up discussion. First, by collaborating with different disciplines and specialists, architects gain in their understanding of end-user needs as well as the sometimes conflicting demands of work processes, management, and budgetary constraints. Second, researchers and practitioners can improve their understanding of the factors that affect how the built environment performs – whether these are political, social or economic factors, building materials or climate change. Lastly, interdisciplinary collaboration between the built environment and other disciplinary experts provides for a greater opportunity to handle complex problems.

Architectural practices and spatial sciences have already begun to understand that the design of buildings and urban spaces has a tremendous effect on our health and wellbeing. Many of the different areas of

which real advances in terms of improvement of people's life expectancies come from basic things such as sorting out our sanitation and clean water supply. These are basics that make people feel better and historically these are built environment areas which have had a major influence on medical outcomes. Many geographical regions still have major inequalities and many of these areas have built environment inequalities. Therefore, collaborating across disciplines is not only important historically but is fundamental for building new ways of working and developing new research.

The presentations have raised awareness around the subject of health and wellbeing, but discussions also raised questions of method, the challenges of cross-disciplinary research and indeed the relevance of built environment expertise for addressing key questions in the health sciences. What is the role of architecture and the built environment in health and wellbeing research? What are the generic questions that we are seeking to address when doing this sort of research? The strength of interdisciplinarity research is evident, but the problems it raises, such as disciplinary language barriers or methodological approaches need to be discussed at the outset in order to achieve the best research outcomes. Interdisciplinary research brings together the approaches of different disciplines through shared problem definitions, exchange of methods and new question formulation[4]. In addition, interdisciplinary work often has an applied orientation[5].

Similarly, the medical field is building an understanding of how the built environment could influence medical outcomes. The UCL School of Life and Medical Sciences (UCL SLMS) partners with faculties around UCL as well as external bodies and these partnerships are seen as crucial in advancing the research conducted by the school and the field of medicine. One of the multiple interdisciplinary projects in which the school is a significant academic partner is the African Centre for Population Health[6] in South Africa established in 1996. The institute surveyed the population of the poorest part of the world three times per year in the past twelve years for HIV and TB, seeking ways to improve diagnosis, prevention and treatment. Another major mission of the Institute is training the next generation of outstanding African scientists. This is a project where the built environment, transportation, education and research come together to support innovation and discoveries.

The BRE concluded with a demonstration of a current CASA project in partnership with the EPSRC, i-sense and the UCL Africa Health Research Institute (AHRI) in South Africa. The aim of the project is to develop a set of new Data Dashboards for a Treatment as Prevention (TasP) HIV trial being undertaken in rural South Africa. Building on a wealth of near-real-time health-related data, the Dashboards present data visualisations which highlight where patient linkage to HIV care has been successful, and provide operational staff with an ability to perform drill-down analysis into causes having impact on the trial. Further collaborations with AHRI and other health institutions, building on similar principles, are currently being explored.

The event provided a wide range of different examples of what built environment and health research might be. Various suggestions were given by the speakers how to achieve future collaborations. There was consensus that there is no single answer to this question because collaboration is context specific and what could work in one case may not be applicable to another. Moreover, sometimes it is good to bring different disciplines together and sometimes it is fine to keep them apart.

[4] Eigenbrode et al. 2007.
[5] Thompson Klein 1996.
[6] http://www.africacentre.ac.za/.

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