An Anthropological Inquiry by Design Towards Improving Indoor Air Quality within Hospital Settings

Report of the Senior Fellowship of Wendy Gunn [grant n° SF/16/014]

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Research results

Work package 1 (WP1) One of the principle aims of WP1 was to identify limits and potentials of qualitative and quantitative methodologies involved in assessment of IAQ in hospitals. Analysis objectives attend to architectural and engineering design and its influence on shaping IAQ, and on hospital occupants' health. This involved a literature review to inform methodological analysis of four cases; detailing a framework for methodological analysis; presentation of main findings as reported in cases and main findings from analysis of methodology and methods employed in each case; discussion of implications of findings of case studies for architecture and engineering design. The main limits and potentials identified:

Limits

- documenting contextual and processual data are too complex for measurement as individual quantitative variables.
- issues of temporality and spatial variability challenge research methodology prioritising stationary sampling in measuring patients, staff and visitors IAQ exposure. Non-parametric multivariate statistical analysis of variance could therefore be one important method in testing effects of architectural design.
- analysis of empirical materials from patients, hospital staff and visitors cannot be limited by linear interpolation, due to the interpolation of functions of more than one variable i.e. movement of hospital occupants results in scattered data.

Potentials

- introducing qualitative methodologies and methods in data collection of IAQ (perceived and measured) within hospital healthcare settings can contribute to expanding IAQ measurement models by introducing diversity and variation of hospital indoor and outdoor air quality and health outcome variables.
- qualitative and quantitative methodological dialogue can expand data collection by providing contextual and processual multi-variable forms of data of IAQ in hospitals.
- using non-parametric combination methodology offers researchers capacity to evaluate both single and multiple variables. Methods of non-parametric multivariate analysis of variance could inform future research in understanding effects of ventilation air sources on microbial communities and circulation of airborne bacteria on health of patients, hospital staff and visitors.

Work package 2 (WP2) studies how qualitative analysis of sensorial experience and perceptual acuity of air quality could be involved in the architectural and environmental design engineering of hospital settings. *Outcomes from WP2 substantiates claim made in WP4* that research could be leveraged to inform architectural and engineering design, if greater attention was given to how to move research into architectural and engineering processes and practices. Engaging into a dialogue between qualitative and quantitative methodologies can expand data collection by providing contextual and processual multi-variable forms of data in hospitals related to indoor microbiology, chemical exposure, human health and hospital buildings. Such transdisciplinary dialogue offers an opportunity to reconsider how indoor air quality data are collected and analysed. Based upon findings from analysis of a workshop (see work package 4) involving architects, engineers and healthcare researchers; I argue anthropological knowledge concerning sensorial experience and perceptual acuity influences architectural and engineering design and practices of future making depending on how knowledge is disseminated among design practitioners by collaborating anthropologists. The output of this work package is a theoretical contribution that is an exploration of Barad's concepts of intra-action and agential realism in relation to sensorial knowledge practices and affect. Here focus is given to how researchers can engage with and take seriously sensorial and affective aspects of collaborative research. Main conclusions suggest engagement and dissemination are not auxiliary to research endeavour, but intrinsic to the research process itself. The output connected to this work package achieves my research fellowships first aim to consider architectural and environmental engineering design processes and future making practices of care(*ful*) design as an anthropological exploration of creativity whereby people shape and are shaped by their ongoing *intra-actions* with buildings (Barad 2003, Ingold 2016)

Work package 3(WP3) My main findings in this work package from a review of existing research design frameworks and standards for assessing sensory experience and perceptual acuity of hospital IAQ indicate lived experience of hospital IAQ is variable and variation exists in sensory experience and perceptual acuity between staff and patients, individual patients, and age groups despite being exposed to the same IAQ conditions. As such, variability and variation should be considered when designing systems of measurement to quantify health risk from exposure to contaminated air. Based upon these findings, I proposed an experiment in the form of an outline for combining qualitative and quantitative methodologies and methods in data collection about IAQ (perceived and measured) within hospitals. The goal of the outline is to inform future studies of assessing IAQ within hospitals. The initial outline was presented to at the *Design for Wellbeing Symposium*, Melbourne, Australia, 7 Dec 2017. Feedback from architects, engineers and healthcare professionals at the symposium helped develop WP3's output concerning discussion of the importance of multidisciplinary research for measuring hospital IAQ and impact this will have in terms of research methods for correlating and co-analysing different kinds of evidence. Integral to preparation of the output for WP3, I gained valuable experience of designing an outline to inform a future pilot or basis for a more detailed, comprehensive and large study drawing from interdisciplinary research methodologies implemented in the Natural Sciences, Engineering and Social Sciences.This involved becoming familiar with ethical issues related to working with patients', staff's and visitors' and challenges associated with implementing research results in healthcare settings.

Work package 4 (WP4) The outcome of this work package was the analysis of empirical materials generated through a transdisciplinary workshop (held at University of Sussex, 2016) involving academics, architectural and engineering practitioners and healthcare researchers. The focus of the workshop was to enable workshop participants to contribute to collaborative research focusing on improving air quality in hospitals by combining architectural elements, environmental engineering systems and biotechnology. Analysis of empirical materials generated from the workshop provided an opportunity to pull together findings from WP 1, 2, 3 towards co-analysis of workshop materials focusing on how anthropological knowledge concerning sensory experience and perceptual acuity can influence architecture and engineering design depending on how knowledge is disseminated among design practitioners by collaborating anthropologists. Since focus in this work package was given to the analysis of documentation of an actual live example of moving research on hospital indoor air quality into architectural and engineering design processes and practices of future making**,** the outcome from the analysis of the workshop was integrated into WP 2 output in the form of a journal article. The focus on design materials utilised for engagement and dissemination of research in this work package contributes to the second aim of my research fellowship to expand the notion of anthropology by means of design. In anthropology disciplinary investigations of architectural design and environmental engineering design practice(s) have been limited to anthropology of design and for design; by means of design is however less developed.

Overall value of the fellowship and potential impact

The third aim of the original SF application was to initiate collaborative research between myself*,* Research[x]Design (Dept. of Architecture) and Building Physics (Dept. of Civil Engineering) at KU Leuven. The fellowship created an opportunity for interdisciplinary and cross department dialogue on a regular basis. As the research outputs indicate, these dialogues led to collaborations in research and joint outcomes including manuscripts for journal articles and ideas for a joint application (see below). Given the time it takes to build such a dialogue across disciplines and between academics, practitioners and health professionals, this aspect of the fellowship should not be underestimated in terms of achieving the original fellowship aim.

Potential impact

Depending upon future structural collaboration, research results could inform development of joint research funding applications involving PhD projects. Specifically, suggestions for different methodological approaches required for involving sensory experience and perceptual acuity as parameters in architectural and engineering design processes, the outline for conducting fieldwork combining qualitative and quantitative methodologies and methods; a framework for correlating and co-analysis of qualitative and quantitative materials could be utilised to inform research design of future research projects in hospital settings. As I write, Research[x]Design and Building Physics have jointly applied for an FWO PhD fellowship about indoor climate in hospital environments (decision pending). Subsequent applications could build upon the extensive international network developed during my fellowship, across academia, architecture, engineering design and healthcare professions.

3. Publication output

Publication output related directly to fellowship

Articles IT x 3
Note: *since the manuscripts below have not been accepted for publication yet, they haven't been inserted in Lirias.*

Gunn, W., Saelens, D., Heylighen, A (submitted, under review). *Building Research & Information*. Taylor & Francis Online. Perceiving and measuring air quality within hospital environments. 2016 Impact factor 3.136.

Gunn, W., Saelens, D., Heylighen, A (submitted, under review). *Technology | Architecture + Design.* Taylor & Francis. Involving sensory experience and perceptual acuity as parameters in hospital design.

Gunn, W., Saelens, D., Heylighen, A (abstract accepted). *Human Ecology Review*. ANU Press. Moving collaborative research on indoor air quality into architectural and engineering design processes and practices of future making. ANU Press. 2014 Impact factor 1.3.

IMa x 6
Note: *Invited keynote lectures and presentations were not planned as part of the original fellowship application. However, significant interest was generated by the research leading to a series of externally funded invitations. These opportunities enabled ongoing external critique and helped to contextualise emerging research issues between academic research, architectural and engineering design practice, and healthcare settings. Importantly, ongoing external critique also helped to develop work package publication deliverables. The lectures and presentations also served to engage a wider research audience with the original fellowship aims and objectives.*

Gunn, W., Saelens, D., Heylighen, A. 2018. Invited keynote lecture. The human ecology of the microcosmos. Navigating complexity: human-environmental solutions for a challenging future. *XXIII Society for Human Ecology International Conference*, Lisbon, 7th-10th July.

Gunn, W., Saelens, D., Heylighen, A. 2018. Invited keynote lecture. An anthropological inquiry by design towards improving indoor air quality within hospital settings. *Design & Environment Interdisciplinary and Output Orientated Workshop.* University of Leeds, Leeds, England, 1st March.

Gunn, W., Saelens, D., Heylighen, A. 2017. Invited lecture. Involving sensory experience and perceptual acuity as parameters in the design of hospitals. *Design for Wellbeing Symposium.* Digital Ethnography Research Centre (DERC). RMIT University, Melbourne, Australia, 7th December.

Gunn, W. 2017. Invited keynote lecture and commentator for research presentations. Movement of collaborative research inquiry into engineering and architectural design

processes and practices of future making. *Media Ethnography of Co-operation Research Centre Symposium.* University of Siegen, Siegen, Germany, 18th July.

Gunn, W 2017. Invited lecture. Movement of collaborative research inquiry into architectural and engineering design processes and practices. IDA: The Danish Association of Engineers, Copenhagen, Denmark, 2nd May.

Gunn, W 2017. Invited lecture. Experiencing and designing hospital environments: How to nurture the health and well-being of patients, staff and visitors by improving air quality in hospital settings? SINTEF, Trondheim, Norway, 25th April.

Publication output not related directly to fellowship

Articles IT x 1
Journal article
Ventura, J. and Gunn, W. 2017. Now you see me, now you don't: Medical design anthropology, improvisational practices and future imaginings. *Anthropology in Action: Journal for Applied Anthropology in Policy and Practice, 24 (3) 45-55. Berghahn Journals.*

Chapters/ Articles in Books IHb x1
Book chapter
Gunn, W. 2018. Collaborative forms. In S. Bunn (ed.). *Anthropology and Beauty: From Aesthetics to Creativity.* London: Routledge.