A Case Study of adopting BIT-Kit: A Method Uncovering the Impact Buildings have on People.

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Abstract

In current architectural discourse there is a lack of method in building evidence to understand the link between buildings and the wellbeing, independence and mobility of the people who use them. In response to this knowledge gap, the Building Interactions Toolkit (BIT-Kit) supports the gathering of real-world interaction evidence within buildings. Applying a mixed-methods approach, BIT-Kit evidence is generated through the combination of purposeful conversation, observation and building interaction data.

This paper introduces the motivations behind BIT-Kit and evaluates evidence uncovered through a case study, which investigates the task of way-finding in a public building by persons with visual impairment. Findings illustrate novel evidence of human interaction with architectural elements (such as stairs, doors, car-parks and corridors) that enable and disable building users. These findings define evidence in assessing the impact of buildings on people.

Background and Context: Missing Evidence

Described as a process of 'learning by doing' (Lawson, 2006) Architects work from the abstract concept to the real-life construction of environments for daily human interactions. However, within architectural discourse the gathering and analysing of evidence to understand the impact of these building interactions is scarce. Stephen Hodder, 2013/14 President of the Royal Institute for British Architects (RIBA), outlines the problem:

"What's missing is the evidence. There is no evidence that good design improves people's lives. If we can demonstrate that architecture can bring economic value or improve performance in workplaces or engender a better sense of community, we can elevate design up the government's agenda." (Hopkirk, 2013)

The built environment is the context for every single human activity. However, regardless of current guidance and building legislation, buildings still exclude many different types of users (Arthur & Passini, 1992; Imrie & Hall, 2001). In designing for social inclusion, other professions are ahead of architecture in recognising the importance of engaging and collaborating with users in 'real-world' contexts.

Disciplines such as Human Computing Interaction (HCI), Product Design and Business Studies are becoming increasingly skilled in developing methods to gather evidence in assessing the requirements, desires and wants of their users. However, this emphasise on direct user engagement is not the norm within the architectural design process (Sailer, Budgen, Lonsdale, & Penn, 2007). Instead, the users 'voice' often becomes lost as individual perspectives, rich narrative and tacit experiences are diluted when converted into legislation, guidelines (Cave, 2007) and access checklists (Lacey, 2003). Popular strategies of utilising 'specialists', proxy users and simulating human conditions (e.g. impairment) are also frequently adopted, yet flawed in reliability (Davis & Lifchez, 1987).

There is a need to holistically investigate evidence associated with the intrinsic link between buildings and the wellbeing of those who occupy them. Rigorous architectural methods (set within buildings) to understand the needs of real life users are needed. In progressing the ability to 'build well, live well' a user-focus is recognised as the driver to uncover evidence of the impact buildings have on people. The overall question becomes: *How do buildings impact on the wellbeing of the people who inhabit and use them?*

In building a method towards answering this larger architectural research question, the Building Interactions Toolkit (BIT-Kit) is an approach to uncover the evidence of how buildings impact on people. BIT-Kit is composed of a mixed-method approach that incorporates purposeful conversation, observations and building interaction data. A sensor-fusion of data (all elements together) provides robust evidence in understanding the human interactions that take place in buildings. The evidence extracted can be understood in relation to the type of interaction, architectural context, spatial conditions, temporal conditions, social constraints and impact of elements of architecture (micro and macro conditions).

In this paper BIT-Kit is introduced and evaluated through a case study of way-finding task in a public building by persons with visual impairment (McIntyre, 2011). The findings exemplify the types of novel, contextual and generalisable evidence uncovered. Discussion focuses on the successes, limitations and next steps of using BIT-Kit to further understand how buildings impact on the wellbeing of people who use them.

Building Interactions Toolkit (BIT-Kit): A Research Methodology

BIT-Kit was designed out of a need to gather evidence investigating the impact buildings have on people. There was an absence of methodology that would fully meet the needs of this type of investigation. Therefore BIT-Kit's theoretical foundation was created from a combination of principals borrowed from the established approaches of Grounded Theory (Glaser, 1968) and Case Study (Yin, 2003), in addition to methods adopted in Architecture.

BIT-Kit: Research Principals

BIT-Kit was built from 15 research principles which incorporated research factors of: 1) subject and setting, 2) process and analysis and, 3) evaluation and rigour. These principals (defined in Table 1) guided the research.

Subject & Setting	
1. Build a Theoretical Description in relation to a Research Problem	Research begins with a problem to investigate as opposed to a hypothesis to test. Research questions and themes fuel the pursuit to generate robust theoretical description (insight into the problem). Research ends with a theoretical description generated from the iterative activity of data collection, collation and analysis.
2. Work in a 'Real-World' Context	Setting: Research is undertaken within the real-world context of the research problem (e.g. in a building)
	Participants: Research is undertaken with 'users' in relation to the research problem/setting. (i.e. not proxy users)
3. Participants Generate Data, Work Ethically	The involvement of people in research determines that ethical protocols must be followed to ensure that neither participants nor researchers come to harm. The participants generate the data that informs the description.
Process & Analysis	
4. Connect with Precedent and Relevant Literature	Literature can be utilised to: simulate theoretical sensitivity, be a secondary source of data, simulate questions and be a source of supplementary validation (Strauss and Corbin 1990)
5. Undertake Data Collection and Analysis as an Interrelated Process	Data generation, transcribing and analysing are sequential components. This enables the Researcher to understand, develop method and collate the data as it is produced (Corbin and Strauss, 1990).
6. Purposively Sample	The initial sample is selected based on what the Researcher wants to find out. From this, the next sample and the next (and so on) are selected based on the aim to strengthen and also challenge the emerging codes and theory. In using grounded theory methodology the sample is emergent and the assumption is that the theory is concealed in the data is to be discovered (Corbin and Strauss, 1990).
7. Methods must Uncover Holistic Experience	In order to *explore the research questions* different methods of data collection can be utilised when using Grounded Theory (Corbin and Strauss, 1990). Robson (2002) encourages a multi-method enquiry. Interpretive-based multi-method investigation forms a major part of this principle and will provide data relating to collection of experiences, thoughts, forms and extents of contextual interaction. The objective is to use any method that works to give as much insight to the problem as possible.
8. Analysis: Coding and Categories emerge from the Data	Data is constantly compared and each set of data is coded as soon as it is produced. Through the process of coding (open, selective and axial coding (Corbin and Strauss, 1990) theory emerges. As the data collection and coding proceeds, the codes and the memos and diagrams accumulate.
9. Making, Producing and Evolving: Theoretical Memos	As soon as data is gathered the first set of memos are developed. It ensures that the Researcher is able to deal with and record the developing nature of the codes. This is a continuous activity and coding should be interrupted to write memos based on new concepts. It is also vital that relationships from theoretical memos are related to other data. This allows for verification.
Evaluation & Rigor	
10. Work with Others	As a measure to prevent a prejudice, others should always critique the Researcher's analysis. This aids in challenging the codes, categories and relationships as well as increasing 'theoretical sensitivity' (Glaser, 1968).
11. Theory is Validated by Empirical Data	Theory is validated by empirical data and evidence base is built up and, through the procedures outlined within *Process and Analysis,* a theory is constructed. The theory is based on the data.
12. Research Progresses in a Reflexive Way	In adopting a reflexive mind-set, the Researcher is able to take a step back and critically assess awareness, preconceptions and decisions made throughout the research process.
13. The Research Process is Transparent	In providing all the details in regard to how the research was carried out the Researcher is enabling others to assess their work by remaining open to critique. This can aid in establishing reliability (Wisker, 2007).
14. Methods are Triangulated	By employing multiple methods, as opposed to a single method, a Researcher can avoid bias that originates from single methods. This can prevent against vulnerability that may be associated with one method.
15. Findings are Transferable	Also referred to as external validity (Wisker, 2007), specific experiences are able to be related to more general hierarchical themes and concepts. This enables findings to be applied to other contexts.

Table 1 BIT-Kit Research Principals

Technical Case Study: Way-finding Scenario

This case study demonstrates the application of BIT-Kit within the real-world scenario of way-finding in a non-domestic, public building.

Context of the Problem

The built environment is failing to support people who have a form of visual impairment (Barker, Barrick, Wilson, Royal National Institute for the Blind,, 1995) and the task of way-finding in non-domestic buildings is particular problem (Arthur & Passini, 1992). There is a scarcity of evidence for architects to fully understand the impact a building has on what enables and disables these users as they find their way from a starting point to a destination. This leads to a research question:

> *Can BIT-Kit uncover evidence of the impact non-domestic buildings have on the task of Way-finding by people with visual impairment?*

The Participants

10 participants (5 male and 5 female), who had a range of visual impairment, took part in the study. Table 2 provides an overview to the participants and gives insight into the participant demographic information, their self-definition of their visual impairment, the types of way-finding aids they currently use and if they had undertaken orientation and mobility training.

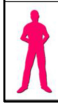
Participant Details		Self-definition of Visual Ability	Way-finding Aid	O&M Training	Braille / Text/ Audio
 **Alfie**	Age: 60-70 Age of Visual Loss: 55 years old	*'I am in total darkness all the time [...] I can see nothing'*	Symbol Cane [Image in Appendix B]	No	Audio
 **Katie**	Age: 40-50 Age of Visual Loss: 21 years old	*'Totally blind'* *'I have no useful sight at all when I am out and about'*	Guide-Dog [Bruno]	Yes	Braille
 **James**	Age: 50-60 Age of Visual Loss: *'Blind since birth'*	*'Registered Blind [...]* *'My sight has stayed the same as it always was'*	Roller Cane [Image in Appendix B] *'You can feel the whole surface area on the ground.'*	Yes	Braille
 **Evie**	Age: 60-70 Age of Visual Loss: 50 years old	Degenerative sight-loss Peripheral vision Sensitive to light Double vision	Currently: Sliding Cane Future: A Guide-Dog.	Yes	Audio
 **Lily**	Age: 30-40 Age of Visual Loss: *'I started to lose my sight when I was 13 [...]. At 21 it got worse'*	Degenerative sight-loss. *'I can only see things that are really close to my face.'*	White Cane	Yes	Audio
 **Adam**	Age: 20 Age of Visual Loss: Genetic Condition Since Birth	Degenerative sight-loss *'no working iris'* sensitive to light *'[...] quite short-sighted and registered partially sighted'.* Wears prescription lenses.	No Aid	Yes	Large Text [Size 16 +]
 **Emma**	Age: 20-25 Age of Visual Loss: 4 years old	No vision in her left eye Small amount ['10%-15%'] of vision in her right eye.	Long Cane or an *'occasional borrowed elbow of a friend'*	No	Audio
 **Jack**	Age: 20-30 Age of Visual Loss: not defined	Cannot see anything using his peripheral vision. *'I can only really see straight ahead.'* Wears corrective lenses and uses a wheelchair.	Dave, [Jacks Assistant] helped him with daily tasks such as getting around buildings.	No	Large Text [Size 16 +]
 **Grace**	Age: 40-50 Age of Visual Loss: not defined	*'I am either short or long sighted'* Sight-loss corrected with lenses.	No Aid	No	Text
 **Ben**	Age: 20-30 Age of Visual Loss: N/A	*'no visual loss at all'*	No Aid	No	Text

Table 2 The Participants

The Case Study: Way-finding Scenario

BIT-Kit was utilised to investigate real-life experiential components of way-finding in a non-domestic building by people with a range of visual impairment. Composed of 3 Phases, the Way-finding Scenario(Figure 1) was a mixed-method approach that incorporated purposeful conversation (probing peoples' experience of buildings), observations (active acquisition in noting and recording what is happening) and, building interaction data (building floor plans and peoples' 'trace' of interactions in buildings). Each of these phases is now introduced before an overview of analysis is discussed.

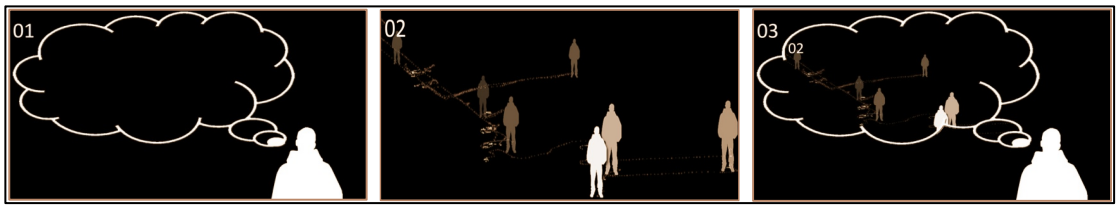


Figure 1 The Way-finding Scenario

Phase 1 - A Chat about Way-finding in Buildings

Purposeful conversation (Burgess, 1982) was adopted as an unobtrusive way to initially gather narrative of general way-finding topics and experiences of Participants' way-finding in buildings. The purposeful conversation was a planned approach that utilised an initial framework of topics (Table 3).

Purposeful Conversation Topics	
Top level themes:	Questions relating to:
Participant Details	Age, occupation, hobbies etc. Self-definition of visual impairment, Age when visual impairment occurred, Way-finding aids, Orientation and mobility training experience, Preferred reading format
Way-finding Details	General way-finding experiences in public buildings, Environmental inputs (limitations/successes), Sensorial cues (limitations/successes), Familiar and unfamiliar environments Becoming lost, Emergency situations, Entrance and egress, Accidents and hazards, Destinations

Table 3 Initial Purposeful Conversation Topics

Phase 2 - A Way-finding Task: Using a Building

The Participants took part in a way-finding task within the same non-domestic, public building and were asked to find their way from a starting point (the boundary wall of the building) to a destination point (an office within the building).

Phase 3 - A Chat about Way-finding in the Building in Phase 2

A purposeful conversation (Burgess, 1982) about Phase 2 encouraged Participants to talk about experiences of way-finding in a specific building. Participants' memories of previous way-finding experiences were activated by events that happened during Phase 2 and they also talked about these.

Case Study: Data and Analysis

Each conversation, from Phase 1 and 3, was recorded with a Dictaphone and later transcribed for analysis. This data was then put through a process of hermeneutic coding (Figure 2) whereby it was put through a process of open-coding, axial coding and selective coding (Strauss & Corbin, 1990).

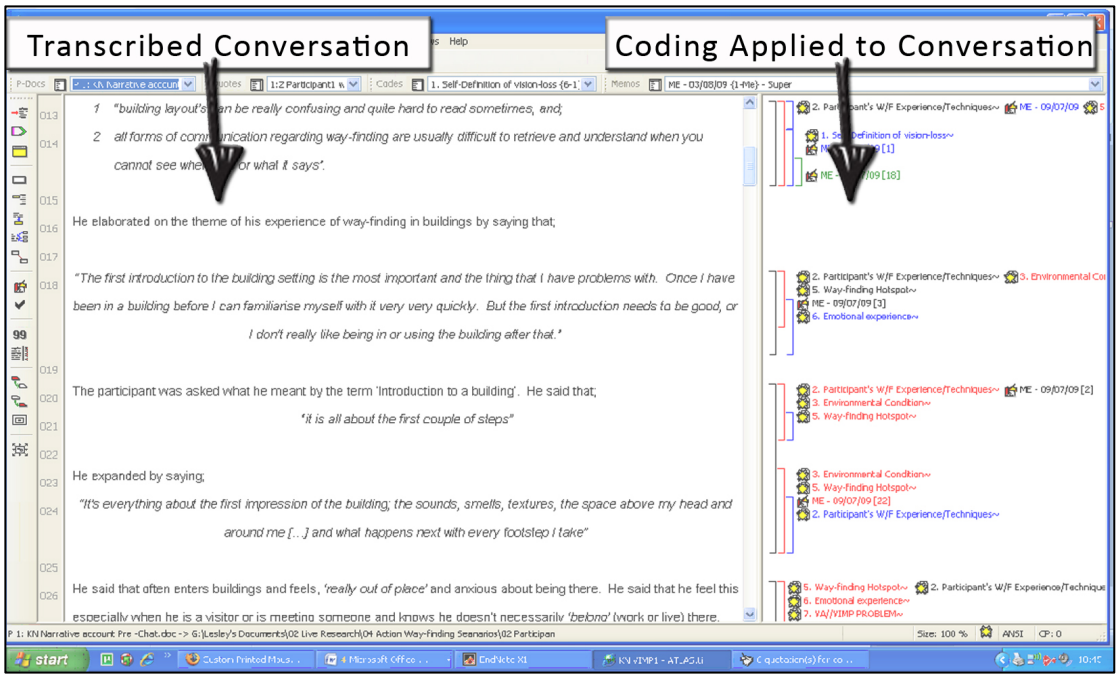


Figure 2 Coding the Purposeful Conversations

In Phase 2 the participants carried a small digital video recorder that captured their 'way-finding encounters'. This quantitative data was transcribed onto floor plans of the building and became the participants 'Way-finding Trace' (Figure 3) still images were also captured and aided in building understanding of what was actually happening at specific points in the building (Figure 4).

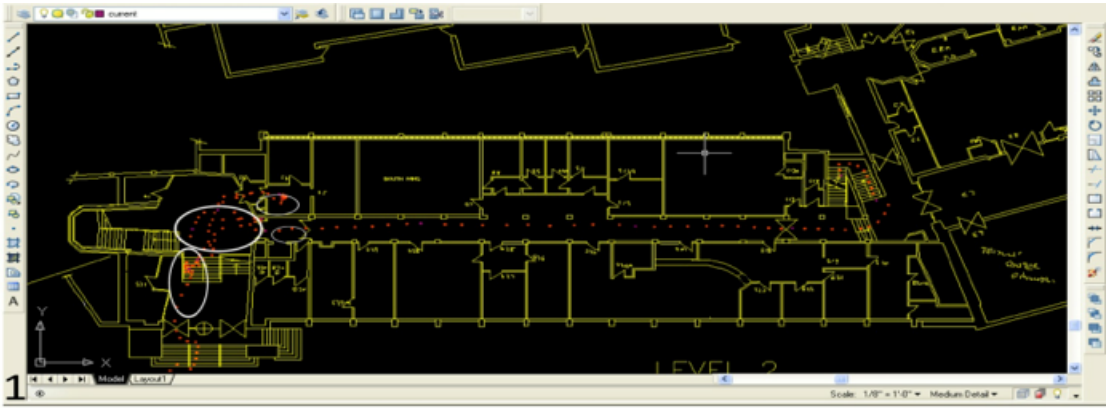


Figure 3 Plotting the Way-finding Trace

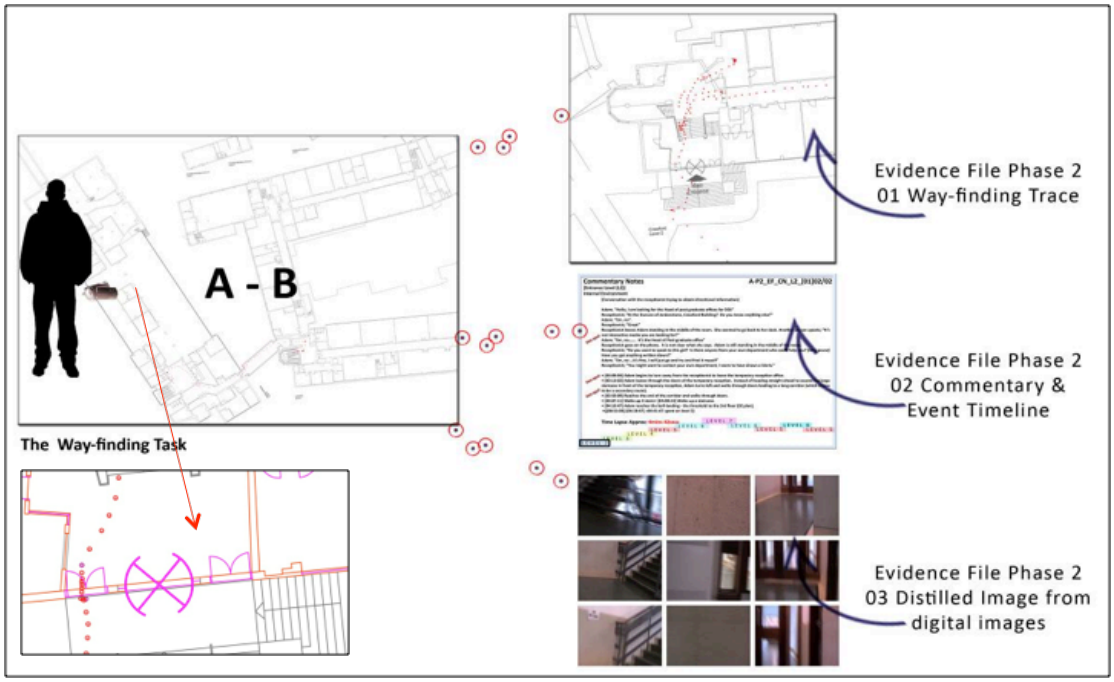


Figure 4 The Way-finding Trace Data

Each Way-finding Scenario (including data collection and analysis) influenced the next. From these 3 phases a range of both qualitative (e.g. conversational data) and quantitative data (e.g. way-finding trace data) was gathered. Each set of data was coded and as analysis evolved, the codes, memos and diagrams accumulated. Theory relating to the impact of a *Way-finding Journey* in a non-domestic building, experienced by people who had visual impairment, emerged.

Case Study Results: Evidence of end user needs

Using BIT-Kit within this case study has uncovered both qualitative and quantitative evidence of what enables and disables the task of way-finding by people with visual impairment. Through analysis of data it emerged that there were critical events and occurrences, coined 'hot-spots', which occurred within a way-finding journey and impacted on a way-finders experience of using the building. They were spatial conditions, social interactions, or temporal events. Hot-spots were positive experiences such as using ground textures to find the front door of a building or being able to break a journey to find the toilets. Hotspots were also negative experiences such as not being able to understand or use way-finding signage or not being able to find and follow a route through a building because of a change of use or extension. The hot-spots uncovered were the evidence to understand the impact the building had on the people using it.

Finding Hot-spots in the Data

The challenge, when working with this data set, was the synthesis of different types of data (i.e. conversation, floor plans, still images and film footage). Once this was achieved, there were different ways to identify hot-spots.

1. Way-finding quotes relating to general way-finding experience (Phase 1).

In the purposeful conversation data hot-spots were identified when the participants referred to way-finding being hindered or enhanced by an event in a building such as Adam's experience with a change in light levels:

> *' light is a problem. It's the change, the difference between light levels in a building that is quite bad. Sometimes when you walk into a stairwell and natural light reflects off a surface it can be dazzling. I often walk into walls because of this.'*

2. Way-finding Trace capturing experiences of the way-finding task (Phase 2).

Within the Way-finding Trace, which was specific to that building, hotspots were identified by occurrences such as, a clustering effect within a way-finding trace, a way-finding trace slowing in pace, a way-finding trace quickening in pace, or an interesting, random way-finding trace(Figure 5)

Figure 5 **Examples of the types of hot-spots found in the way-finding trace**

3. Way-finding reflection quotes relating to the way-finding encountered during the Way-finding Task (Phase 3). For example, Katie describes her experience of walking through the car-park to get to the entrance of the building (Figure 6).

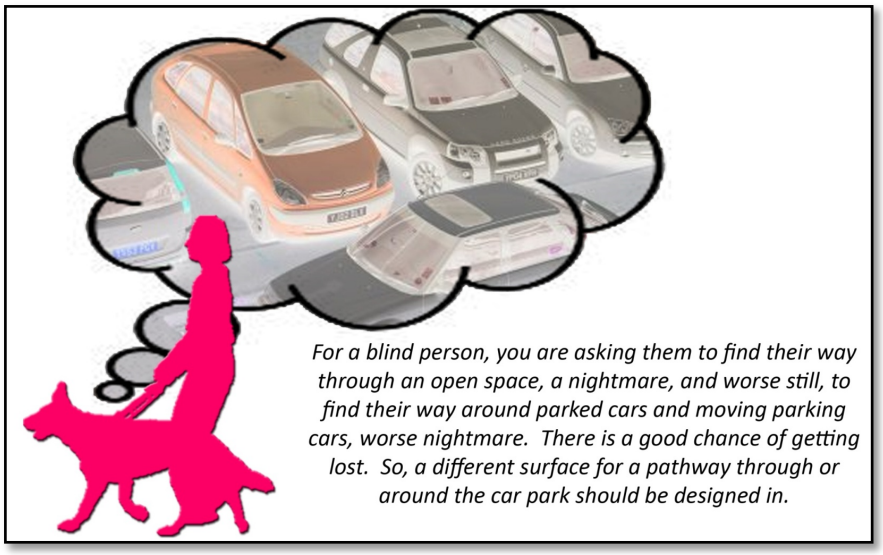


Figure 6 Way-finding Reflection Hot-spot

4. Way-finding quotes and way-finding trace relating to the way-finding encountered during the Way-finding Task (Phase 2 and 3).

When data-fusion occurred between the way-finding trace and the conversation (Phase 3) extra insight about the hotspot was gained (Figure 7)

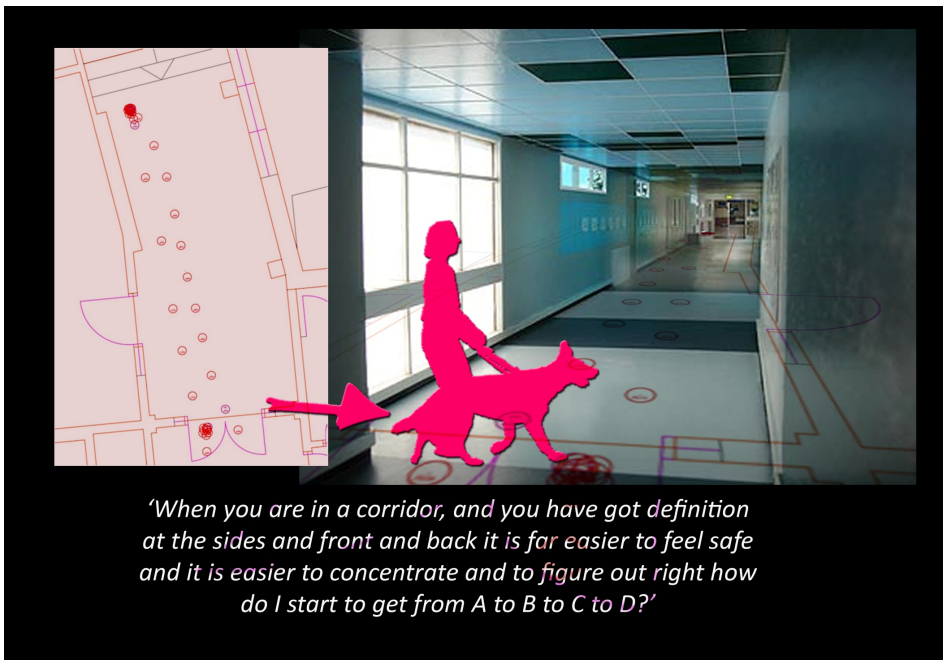


Figure 7 Way-finding Hot-spot from Phase 2 and 3

5. A data-fusion of all 3 phases (data from Phase 1, 2 and 3).

When data-fusion occurred between the general conversation, the way-finding trace and the conversation in phase 3 (Figure 8) this resulted in a particularly generalizable and data triangulated finding.

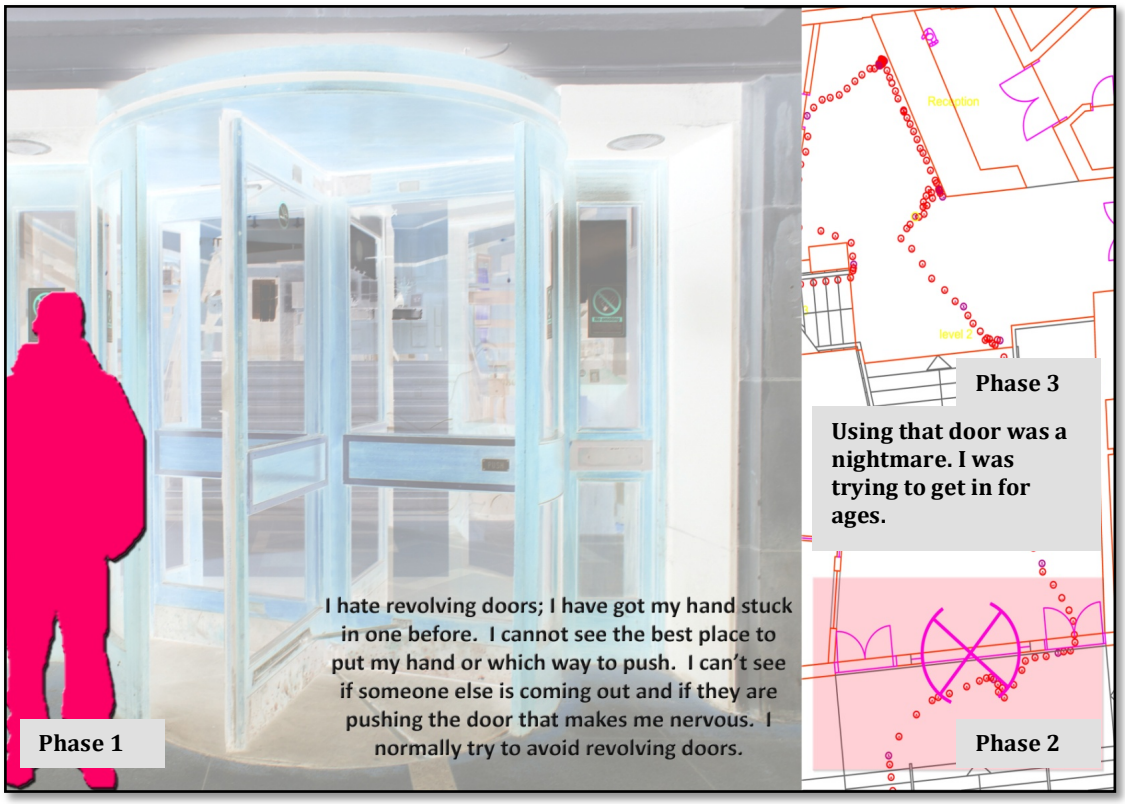


Figure 8 James' Experience (Phase 1,2 and 3)

Hot-spots and BIT-Kit

Although only several can be evidenced here, each of the Hot-spots can be understood in relation to the type of interaction, architectural context, spatial conditions, temporal conditions, social constraints and impact of elements of architecture (micro and macro conditions). Through uncovering the hot-spots, the application of BIT-Kit was successful in uncovering evidence to assess the impact the building has on way-finders who have visual impairment.

BIT-Kit: An Evaluation

Bit-Kit is a tool that gathers evidence to assess the impact the built environment has on people. It takes steps towards answering *How do buildings impact on the wellbeing of the people who inhabit and use them?*

In relation to the case study, which investigated a real-world problem, the Research Principals of BIT-Kit were successful in guiding the research to build a set of specific methods that presented novel, architectural-relevant data.

The successes of BIT-Kit are that methods can be developed in direct response to an architectural case study and research problem. The multi-method approach enabled weaknesses of using one method to be mitigated, for example understanding of the way-finding trace hot-spots could be gained through phases of purposeful conversations. The study also uncovered the holistic impact

(positive and negative hot-spots) a building has on people and the underlying reason(s) for hot-spots occurring in specific locations of buildings.

Several of the findings gathered from using BIT-Kit validate specific elements of current building guidance, others differ and contest current guidance whilst some take understanding further. An important aspect of these findings is that they provide the context of the hot-spot as opposed to specifying prescript 'rules'. This contrasts from current guidance as it puts the designer in the role of creating a context specific solution to the hot-spot, in relation to the building.

The major limitation of BIT-Kit was the time taken to transcribe and analyse the data and if adopted in Architectural practice this would prove to be an expensive method. However, in progressing BIT-Kit further within a new project BESiDE (McIntyre & Hanson, 2013) The Built Environment for Social Inclusion through the Digital Economy) it is an objective that this limitation will be addressed and certain elements, such as analysing the conversations and plotting the interaction trace, will become automated.

Conclusion

There is an intrinsic link between buildings and the wellbeing of those who occupy them. Within architectural discourse the Building Interactions Toolkit (BIT-Kit) is a method that builds evidence to understand the link between buildings and the wellbeing, independence and mobility of the people who use them.

BIT-Kit has been introduced and evaluated through a case study of way-finding task in a public building by persons with visual impairment (McIntyre). In applying a mixed-method approach of purposeful conversation, observation and building interaction data, BIT-kit has been found to be successful in uncovering 'hot-spots' of way-finding in a building by people with visual impairment. The evidence gathered from the way-finding scenarios, direct from the user, has illustrated novel insight into human interaction with buildings. Bit-Kit is an architectural method that has rigorously defined architectural elements that enable and disable people's use of a building. This evidence, along the potential of future evidence from using BIT-Kit, in different buildings experienced by different types of users, provides unique insight for architects to 'build well' to 'live well' in the future of building design.

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