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Front cover:

Modell of the Viva-housing project in Gothenburg presented by the cooperative Housing provider Riksbyggen.

Photo: Sten Gromark.

DESIGN INTERVENTIONS – REFLECTIONS AND PERSPECTIVES FOR URBAN DESIGN RESEARCH

**CECILIE BREINHOLM CHRISTENSEN,
ELIAS MELVIN CHRISTIANSEN AND ANDREA VICTORIA
HERNANDEZ BUENO**

Abstract

The aim of this article is to contribute to the ongoing academic discussion of research-by-design as an approach to produce valuable, design-based research knowledge, specifically focusing on the use of design interventions in urban spaces. This is done with a point of departure in the authors' individual experiences with the use of design interventions in their respective PhD projects. First, the article frames state-of-the-art literature on research-by-design approaches and design interventions. A model is presented as a synthesis of the state-of-the-art literature together with the authors' reflections on and experiences with the use of design interventions in a research-by-design process. The model highlights the aspects of respectively engaging as a designer and distancing as a researcher in different parts of the process. Presenting the use of design interventions in the three different PhD projects sets the background for shared reflections and a critical discussion of potentials and challenges for urban design research. Here, we want to emphasise the potentials of design interventions in enhancing and gaining insights into embodied human experiences in urban spaces. This article, then, advocates for and aims to enable and inspire other design researchers to further explore the values of doing research-by-design through the use of design interventions.

Keywords:

Research-by-design, design interventions, urban design, urban design research methodology, embodied experiences

1. Introducing design interventions in urban design research

Imagine yourself moving through a city. You arrive at the central train station to meet up with some friends for a yearly urban festival, running a bit late. You cross the street in front of the station, and you hurry across, not noticing how pavement and asphalt interchange under your feet as you do. During weekdays, perhaps you catch the metro to and from work. You follow the stream of passengers changing from train to metro through the low transfer tunnel, down the escalators to the underground platform. You do not notice much but follow your body's habituated movements as it guides you past the other passengers. And for holidays and business trips, you go to the airport. Arriving home after a long and tiresome travel, all you want is to get out and embrace your loved ones waiting, navigating signage between shops and restaurants that compete for your attention, following the wooden flooring until you finally reach the exit sign.

The situations described above reveal something about how people engage and make meaning of different urban spaces and they can provide a glimpse into how urban spaces work. We believe that by studying urban life, we can get valuable insights that in turn can inform urban design and enable us to make better urban spaces. But how can we as urban design researchers “capture” the social and embodied interactions and experience that take place in urban spaces? And how can we use such insights to produce valuable research knowledge?

In our respective PhD projects, we individually tried to do so through the use of design interventions in order to produce design-based research understandings; this article presents an effort to critically reflect on and compare our individual experiences with the use of design interventions in urban design research. On this basis, we will discuss the potentials of design interventions as tools for producing design-based research understandings.

However, practical implementation of design interventions in urban spaces, as well as analysing the output, come with their own challenges, which relate to a broader discussion of the value of “designerly ways of knowing” in producing valid research knowledge. Consequently, with a point of departure in our own experiences, it is the aim of this article to contribute to the ongoing debate about research-by-design by critically discussing the use of design interventions, their potentials and challenges. The central question of this article is then, how can design interventions as a design-based approach act as tools for producing valuable research knowledge on urban spaces and for urban design research?

2. From design research to research-by-design

Since the late twentieth century, research on the nature of design practice and processes has flourished (Rittel & Webber, 1973; Buchanan, 1992; Dorst & Cross, 2001; Lawson, 2004; Cross, 2006; Gänshirt, 2007). Such research has characterised design as a discipline by a special way of thinking, or as a “designerly way of knowing” (Lawson, 2004; Cross, 2006). This is, among other reasons, due to the character of design problems as ill-defined and “wicked” (Rittel & Webber, 1973; Buchanan, 1992), where the solution develops iteratively hand-in-hand with the formulation and understanding of the problem (Dorst & Cross, 2001; Lawson, 2004; Cross, 2006; Melles, 2008). This further relates to design as a solution-oriented and “constructive” discipline (Cross, 2006), i.e., as a discipline that is concerned with a world, which is not yet there, but where the design process itself is a matter of specifying and concretising an unspecific subject matter (Buchanan, 1992).

The design discipline is also characterised by an often non-verbal “design language”, or as Cross puts it: “designerly ways of knowing rest on the manipulation of non-verbal codes in the material culture” (Cross, 2006, p. 10). Such manipulation happens through a process of making and testing various solutions, whereby the designer reflectively comes to get a better understanding of both problem and solution (Lawson, 2004; Cross, 2006). In this way, design solutions develop through “a reflective conversation with the situation”, as described by Schön (Cross, 2006, p. 16). This further emphasises a distinction between design processes and products, which are intimately linked but should not be confused.

As such, design practice and thinking are by now relatively well-described, although still hard to specify in exact terms due to their nature (Lawson, 2004). Such research considers design on a general scale that shares the abovementioned characteristics, and ranges from industrial and product design to textile design, graphic design, to architectural and urban design (Buchanan, 1992; Rodgers & Yee, 2015). However, since Christopher Freyling’s publication *Research in Art and Design* from 1993 and his distinction between research *into*, *through* and *for* design, there have been debates about the validity of research-by-design in journals like the *Architectural Research Quarterly* (Lawson, 2002; Megahed, 2017), conferences (T.U. Delft, 2001; de Walsche, 2016), books (Hensel, 2012; Hensel & Nilsson, 2016) and shared experiences from various schools of architecture like RMIT (Blythe & Schaik, 2013) and Sint Lucas School of Architecture (Dunin-Woyseth & Nilsson, 2011). However, no clear consensus on a single, shared method for research-by-design seems to have been reached.

Since around the turn of the millennium, a relational understanding of space and the built environment in geography and the social sciences has also spurred on studies more specifically focused on architectural

design practice (e.g., Yaneva, 2009; Jacobs & Merriman, 2011; Stender, 2016). Along this line, there is a growing interest in how designerly ways of knowing also hold value as a method for knowledge production, rather than merely as an object of study (Dyrssen, 2010; Stam et al., 2019). This is particularly so for design fields and the production of valuable knowledge for design (Fraser, 2013; Rodgers & Yee, 2015), but not exclusively, as exemplified by the emergence of new research fields such as “mobilities design” (Jensen & Lanng, 2017) and “architectural anthropology” (Stender, 2016). Implementations of design as a method for research relate to the use of design thinking and exploration (Dyrssen, 2010; Verbeke, 2013; Jensen & Lanng, 2017). The growing interest in design research methods can be understood in parallel with a greater openness for alternative ways of producing knowledge in research in general, understanding complex urban situations, embracing exploration and regarding research as a creative process to a larger extent as, among others, expressed in non-representational theory (Thrift, 2007; Vannini, 2015; Jensen & Lanng, 2017) and action research (Villari, 2015). In this way, research-by-design challenges the pressure for “generalisable truths” in academia, because designerly ways of knowing insist on specificity and produce exemplary and situated knowledge. Further, the interest in design research methods also parallels a material turn in social sciences, turning focus to the “things” and embodied practices that are part of the social interactions and situations of everyday life, as seen in e.g., actor-network theory (Yaneva, 2009; Jensen & Lanng, 2017).

Engaging as a designer while distancing as a researcher

In general, research-by-design can be characterised by using design products or artefacts (in our case as design interventions), processes and/or experience as tools for, or part of, the research inquiry and knowledge creation. As described by Johan Verbeke “research by design” is ...

... proposed as that kind of research, in which the process of designing, as well as experience gained from practice, plays a crucial role in research – not only as inputs to be observed, but, more importantly, as the actual methods and outcomes of the research itself (Verbeke, 2013, p. 137).

In addition, Murray Fraser elaborates by saying that ...

... architects use the creation of projects, or broader contributions towards design thinking, as the central constituent in a process which also involves the more generalised research activities of thinking, writing, testing, verifying, debating, disseminating, performing, validating and so on (Fraser, 2013, p. 1).

These different perspectives point to how the designer and the researcher overlap, because the researcher engages in the research as a *designer*,

thereby relying on their own design skills, understanding and knowledge, sometimes labelled as tacit knowledge. In the words of Verbeke:

Traditionally, research tries to take a distant view, as it does in architectural history and theory. In research by design, however, it is the researcher who is also the designer, and who develops knowledge through their design activities (Verbeke, 2013, p. 150).

Such engagement, as a designer in the research, can be compared to action research, most prominently used for social studies, and exactly characterised as “an inquiry model that, as the name suggests, links the reflective dimension to practice” (Villari, 2015, p. 306). As highlighted in relation to action research, doing research by design requires both engagement as well as analytical distance in order to produce research understandings (Villari, 2015, Chapter 24).

Projecting possible futures reveals something about the present

The critical potential of design interventions lies in design as “fiction builder”, as a way to project futures that are not (yet) part of the actual world we occupy, but rather of a fictional world (Dunne & Raby, 2013). Projecting possible futures can thus be used as a way to better understand the present (van Toorn, 2007; Dunne & Raby, 2013; DiSalvo et al., 2014; Jensen & Lanng, 2017), as described by Dyrssen in relation to art-based-research:

Thus, modelling and fiction are strategic tools in the staging of explorative experiments and, as important parts in AbR (art-based research), they are actions of active investigation, of knowledge production-interaction in the making, operating in the situation directly, changing the obvious to create or evoke new meanings (Dyrssen, 2010, p. 232).

By generating alternatives, design fictions invite viewers and users to make up their own minds, to reflect and engage, and can thereby help people “construct compasses for navigating new sets of values” (Dunne & Raby, 2013, p. 44). Or, in the words of Dyrssen, to “generate futures that act as catalysts for public debate and discussion about the kinds of futures people really want” (Dunne & Raby, 2013, p. 6).

However, the critical potential lies in maintaining a close link to the everyday known world. If design fictions are too shocking and out of context, they “will be dismissed as art” (Dunne & Raby, 2013, p. 43). As such, the difference to a purely art-based approach is that design also includes functional concerns and engages with issues of everyday life, rather than merely provocative or critical questioning of the status quo.

Provoking situations and material engagement

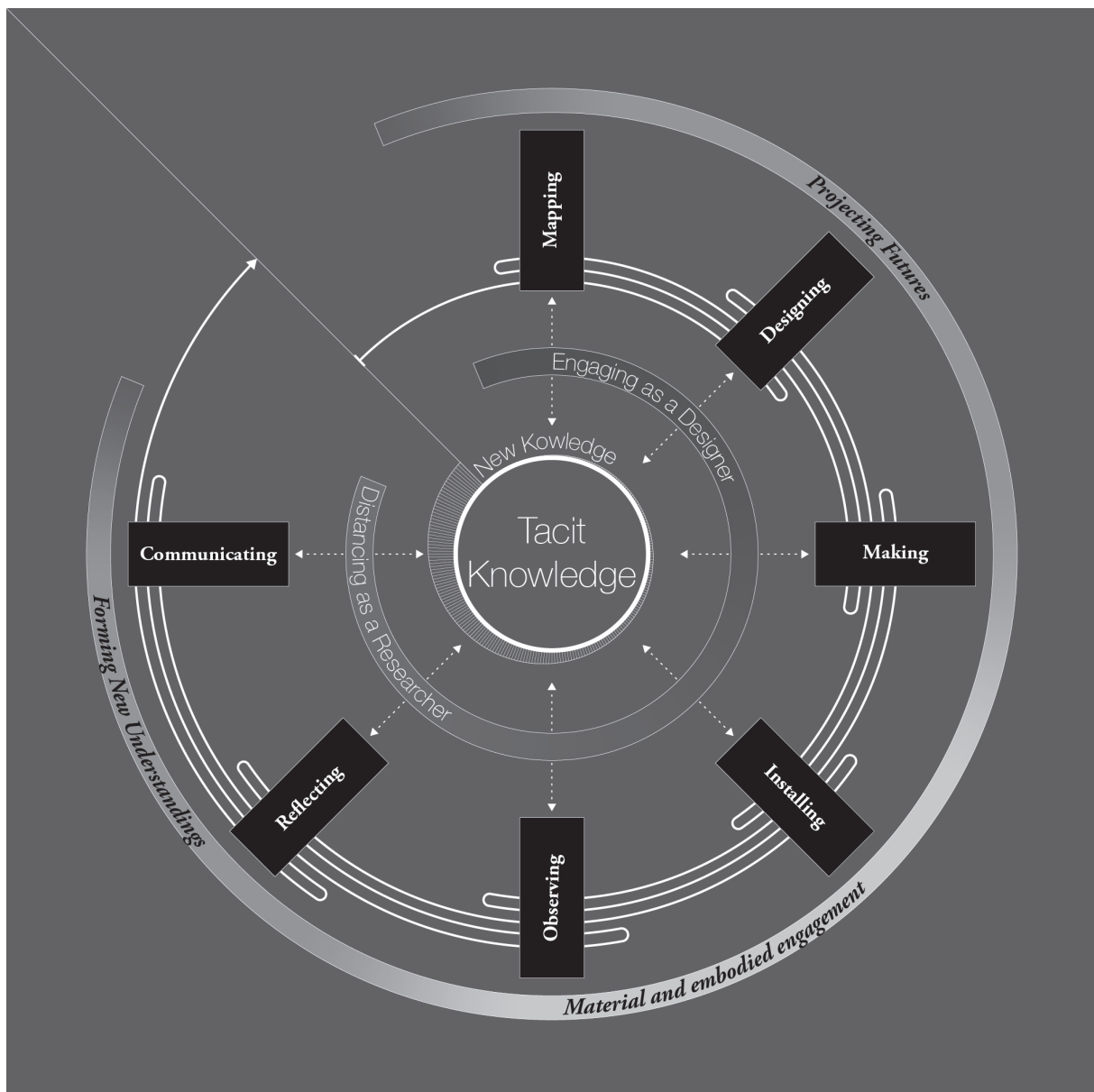
From design fictions, the use of design interventions comes even closer to the actual design process, by crystallising design fictions and ideas into material artefacts to be placed and tested in-situ in field settings (Jensen & Lanng, 2017).

Using design interventions as drivers for research can be seen as a sort of “prototyping” (Wensveen & Matthews, 2015). Wensveen & Matthews outline four different ways of using prototypes, where they “distinguish between cases where the research is driven by or conducted through the prototype, and cases where the *process* of prototyping is the vehicle for inquiry” (2015, p. 264). Here, we shall be concerned with the ways of prototyping, where design interventions are used as a sort of hypothesis testing where the response to the intervention is the focus of inquiry, as well as the process of designing the interventions as a way of producing analytical understandings.

Using design interventions for hypothesis testing can also be seen as a way to provoke situations, where the material setting is altered to study the difference it makes, i.e., which (human) responses it provokes (Jensen & Lanng, 2017). In the words of Dyrssen: “Analysis is accomplished through action, by staging, provoking or changing the situation” (Dyrssen, 2010, p. 227), and she describes this as a “criss-crossing process of invention-intervention-analysis-construction” (2010, p. 236). This then links to performative aspects of design experimentation and the staging of explorative experiments (Dyrssen, 2010). In this way, design interventions link social practices to the material environment. By turning focus to embodied and sensorial responses, design interventions thus hold a potential for gaining insights into the human scale and revealing aspects of human experience (Gehl, 2011; Pallasmaa, 2005).

3. A model for applying design interventions as a research-by-design process

Before introducing how the use of design interventions was applied in the three respective PhD projects, a model is introduced as a graphic representation that synthesises our shared reflections in relation to the state-of-the-art literature. The model shows how we understand the research-by-design process using design interventions as an iterative process, similar to design processes in general (Figure 1).



The model illustrates the research-by-design process as a succession of seven phases that build on tacit, designerly knowledge and how new knowledge is produced on top of that. These phases are connected through an iterative process of *mapping* pre-understandings and analysis of the site for the design intervention; *designing* the intervention; *making* the intervention; *installing* the intervention in-situ; *observing* the effects and human responses; *reflecting* on the analysis and findings; and finally *communicating* the results and conclusions. Each of the seven phases of the model were included in the design interventions described in the following chapter, but with different importance, influence and intensities between them. As such, the model is a graphic representation of our synthesised reflections and experiences with design interventions as part of a research-by-design approach, with the

Figure 1
Model describing the research-by-design process through design interventions in urban design research.

ILLUSTRATION: THE AUTHORS.

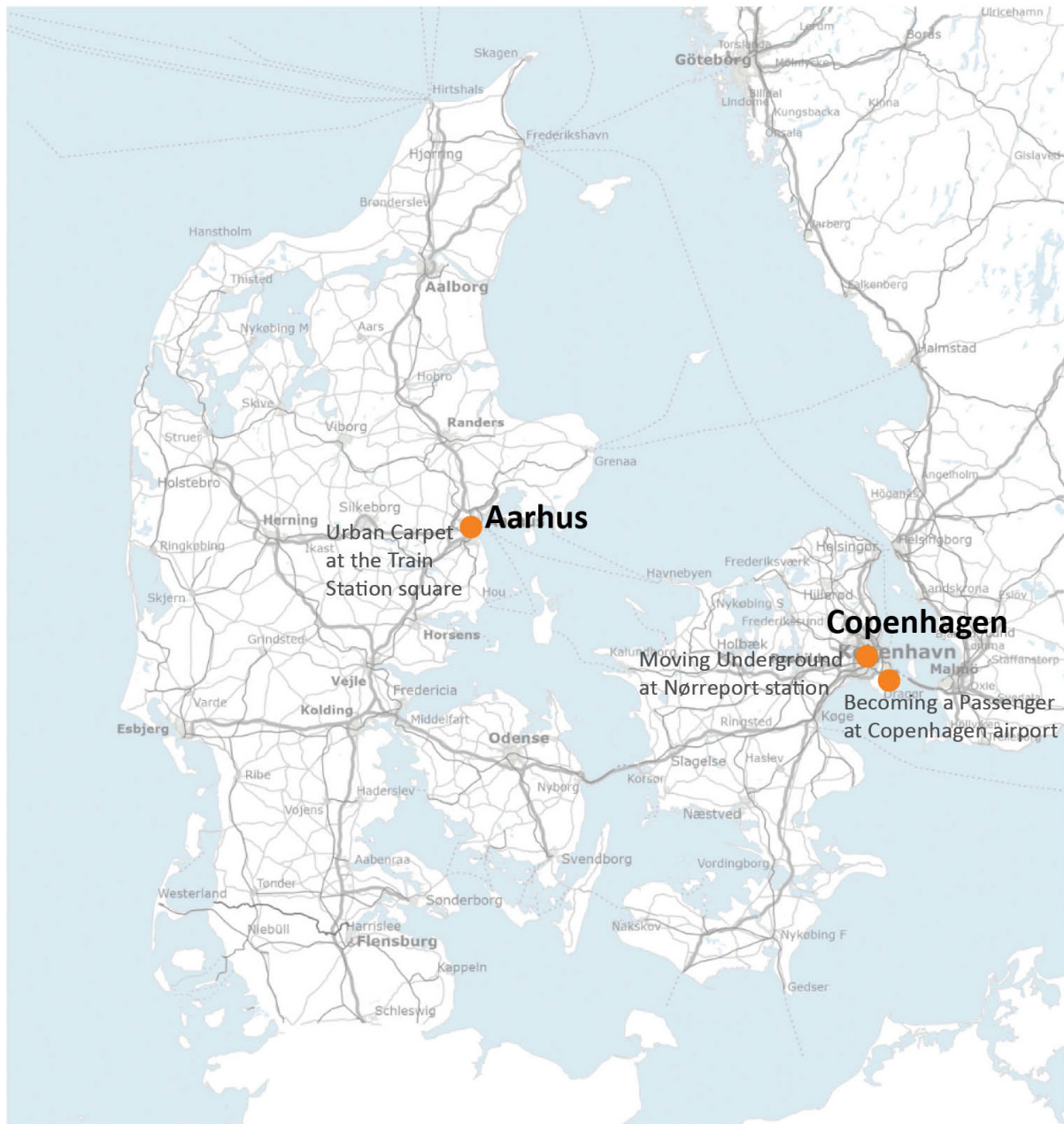
purpose of enabling and eventually guiding other design researchers to engage in similar ventures, and not as a prescriptive recipe for how a research-by-design process using design interventions *should* be conducted. Thus, the model, as well as this article in general, can be seen as part of the forming of new knowledge through reflecting and communicating about our findings across the three PhD projects.

Perhaps the most unique feature of the research-by-design methodology, is that the iterative process reflects a continuous interaction between engaging as a designer and distancing as a researcher. We engage as a designer through mapping the current situation, proposing a design solution for the intervention and by making and installing the design intervention. On the other hand, we distance ourselves as researchers through observing responses to the design interventions, reflecting and forming analytical understandings and ultimately communicating the conclusions. However, the two roles are not exclusively reserved for these parts of the process, and both the designer and the researcher are present throughout the entire process, according to the specificities of the individual study.

The seven phases can be grouped in three main categories: *Projecting Futures*, *Material and Embodied Engagement*, and *Forming New Understandings*.

4. Three examples of design interventions in urban design research

As basis for a critical discussion of the potentials and challenges of research-by-design through the use of design interventions, the following will now present the three authors' respective use of design interventions in their PhD projects. The examples range from placing a wooden "urban carpet" in a pedestrian crossing next to the railway station in Aarhus, the second largest city of Denmark, to placing foil on the floor and coloured light above platform doors of Nørreport Metro station in the centre of Copenhagen, the capital of Denmark, and, finally, to placing light patterns on floors and ceiling as well as light objects in two locations of the Copenhagen Airport (Figure 2). The urban spaces thus vary in terms of ownership, sizes, rules and regulations and whether covered or not.



The following description of the design interventions will follow the structure of the model presented above and reflect the seven phases of *mapping, designing, making, installing, observing, reflecting and communicating*.

Urban carpet

The design intervention Urban carpet was applied in Elias Melvin Christiansen's PhD project "Urban tectonics – In search of a critical perspective on assembling the city" (Christiansen, 2020). The study Urban Carpet was centred around the creation and observation of an urban installation developed in collaboration with Polina Chebotareva, PhD from the

Figure 2
Map showing the locations of the three design interventions in Denmark.

ILLUSTRATION: THE AUTHORS (MAP: STYRELSEN FOR DATAFORSYNING OG EFFEKTIVISERING)

Aarhus School of Architecture (Chebotareva, 2020). The installation was developed and installed for the *Aarhus Festuge 2018*, an annual urban festival in Aarhus.

Banegårdspladsen (the train station square) in Aarhus (Figure 3) is found in the historical centre of the city, and the train station has been placed here for more than a century. Today, the space is not experienced as an important square in the city, and it does not feel as the entrance to Aarhus, as train station squares have the potential to do.



The square has always facilitated a great mix of pedestrians, bikes, cars, buses and, previously, trams. But whereas this coexistence historically has taken place intuitively, the current layout facilitates this by strict control. As a consequence, the current square is fragmented and is predominantly experienced as a space for transit. This means that the more subtle function of welcoming tourists entering the city from the train station or providing an attractive urban space in the centre of the city for people are neglected. From this observation, we approached the design intervention by asking ourselves whether the train station square could offer a richer urban experience?

Figure 3
Overview of Banegårdspladsen with the
refuge island in the center.

PHOTO: KORTFORSYNINGEN

The framework for the design intervention was to introduce an intense atmospheric impression to the pedestrian crossing, affecting the people walking on it by multiple sensual input. This effect was achieved by covering the crossing with a “carpet” of burned wood (Figure 4).



A structural principle inspired by carpet weaving was developed for the design intervention, and the carpet was constructed by small pieces of burned Douglas fir, woven together with wires.

The design intervention was installed during one evening/night and stayed in place for two weeks, while observations of pedestrian’s responses to the installation and their interactions with the carpet were conducted. The carpet mimicked smoothly the topography of the crossing, leaving a soft and different impression compared to the hard asphalt and stone surface usually found on these sites (Figure 5).

Figure 4
Visualisation of the refuge island with the installation, blending in as a “carpet” in the middle of the pedestrian crossing.

PHOTO: ANNE DALL

ILLUSTRATION: ELIAS MELVIN CHRISTIANSEN



Besides providing a different visual impression, the burned surface of the wood pieces dispersed a distinctive smell, and the carpet could be smelled from around the square on the wind. The flexible, structural system allowed the small pieces of wood to be gently pushed together when people walked on them, creating a small xylophone-like sound. Approaching the carpet while pedestrians were crossing the street, a soft melody of clicking wood pieces would fill out the space.

While the carpet was in place, the natural heavy flow of pedestrians could continue unhindered, and even the occasional wheelchair user and baby strollers were not disturbed while crossing the installation (Figure 6).

Occasionally, the installation seemed to have made the pedestrians wonder while they waited for their red light (Figure 7).

Maybe they were taken out of their everyday commute by the sound, the smell and the softness of the surface. Some even spent a little time interacting with the installation, dancing and moving around the carpet.

It is difficult to say within the framework of the presented study if the installation did change how people perceived the square. Observations revealed that people responded to the installation, which perhaps could indicate that there is a potential for the square to be a more engaging urban space. Nevertheless, several aspects of the urban space, and how urban spaces are constructed, were only revealed when engaged with the square as a site for a design intervention. For example, how the site is used during the day and how sensual effects engage pedestrians.

Figure 5
Surface of the installation.

PHOTO: ELIAS MELVIN CHRISTIANSEN



Figure 6
Wheelchair users and baby strollers
passing the design intervention.

PHOTO: ELIAS MELVIN CHRISTIANSEN



Moving underground

Cecilie Breinholt Christensen's PhD project was conducted with the Copenhagen Metro as a primary case (Christensen, 2020). Since the Metro's inauguration in 2002, it has had a steady increase in passenger numbers, which challenges its limited underground space. However, the trains are not necessarily full, thereby pointing to qualitative rather than quantitative aspects of passenger flows, i.e., a matter of the spatial composition of the platform space, rather than of the platform's extent. These "capacity issues" are particularly salient on the underground station of Nørreport, one of the busiest stations in Denmark, and hence the focus on the empirical studies.

Figure 7
People wondered about the presence of
the installation.

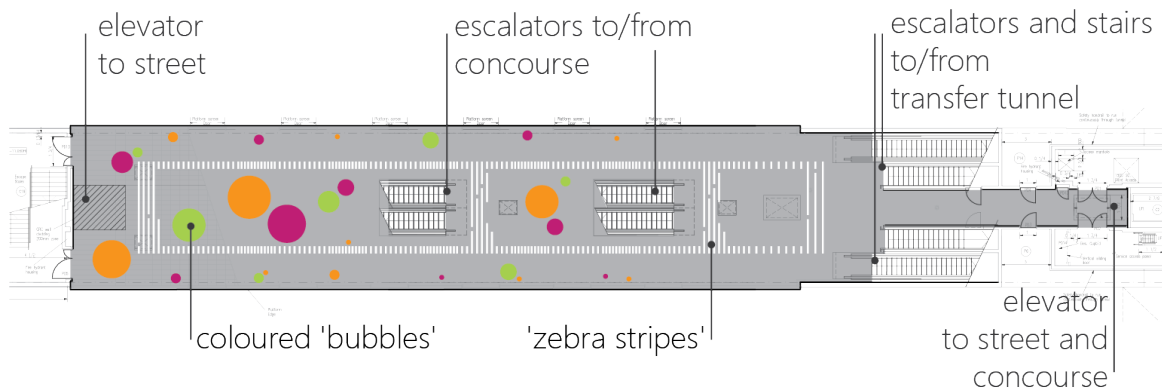
PHOTO: ELIAS MELVIN CHRISTIANSEN

The intention was to tease out affordances of the physical setting for capacity issues, i.e., to study which difference the physical setting and its design and architecture makes for passengers' embodied social practices and their experience of riding the Metro. The overall aim was to create knowledge to inform the design of the future Metro as a "good transit space": combining an urban design concern for creating good public spaces for people with a concern for the functionality of the Metro as a transit space, i.e., combining concerns for the human experience with concerns for the efficiency of movement.

Design interventions were implemented as part of a mixed-methods set-up¹. In this set-up, the design interventions served two purposes. First, they were implemented as a sort of hypothesis testing with the purpose of trying to "solve" capacity issues by making passengers walk further to the back of the platform. Second, they were implemented with a more open intention of "provoking situations", trying to tease out affordances of both the interventions as well as the existing physical setting by analysing the difference they would make.

The empirical studies comprised two iterations of placing and evaluating design interventions in-situ. In the first empirical study, foil was placed on the platform floor as "zebra stripes" and coloured circles (Figure 8). The zebra stripes were supposed to structure passengers' movements by marking a clear path down the platform to walk on and behind which to wait for the train. The coloured circles were intended to invite passengers to place themselves on to wait for the train, as well as adding a colourful appearance to the platform space, to see whether this would have a positive influence on the passengers' experience of the platform. In the second empirical study, light interventions were placed respectively on the back wall of the platform, as a LED curtain, and on the panels above the doors forming a gradient towards the back of the platform. The intention was still to invite passengers to walk further down to the back of the platform and see whether the interventions would have a positive influence on the experience of riding the Metro, but through interventions at eye-height this time, where they were expected to be more visually salient. A solution with light was chosen instead of foil in collaboration with the Copenhagen Metro, since this made it possible to test alternative colour appearances as well as for the fascinating effect of the light, leaving minimal traces on the material setting. Three different expressions of the light were tried out: a graphic pattern in nearly white light, a colour gradient with warm orange light on the back wall and, finally, adding dynamic movement to the light of the colour gradient.

1 This set-up was shared with author Andrea V. Hernandez Bueno and is described in Jensen et al. (2020). However, the two projects were carried out individually, and this article will not elaborate on the methodological considerations related to the specific methodology but restrict itself to account for and reflect on the use of design interventions.



During the first empirical study, it was very easy to observe how passengers engaged with the interventions on the floor. The white zebra stripes did seem to invite passengers to walk on them and wait for the train behind them, as such helping to structure their movements on the platform. This was supposed to help avoid bottleneck situations at the front of the platform. However, it turned out that when the platform started to fill with passengers, the increasing number of human bodies meant that the interventions were rendered “invisible”. Consequently, passengers then moved and placed themselves according to other passengers’ bodies rather than the interventions. In this way, human bodies overruled the interventions (Figure 9).

Figure 8
Illustrations showing the design interventions from the PhD project with the Copenhagen Metro as case. From top left to bottom right: 1) plan drawing of the Nørreport metro station platform showing the placement of the “zebra stripes” and the coloured circles of the first empirical study, 2) photos of the “zebra stripes” and coloured circles, 3) the light interventions of the second empirical study.

PLAN DRAWING AND PHOTO: CECILIE B. CHRISTENSEN
(WITH PERMISSION FROM THE COPENHAGEN METRO).



Figure 9
Observations of passenger's interactions with the zebra stripes on the platform floor.

PHOTO: CECILIE B. CHRISTENSEN.

Passengers were also observed interacting with the coloured circles, e.g., children playing with them, jumping from one to the other, and they were used for gathering a group of kindergarten children (Figure 10). When placing the light interventions, it was however very difficult to observe the passengers' interactions with them, because they were placed at eye-height. Consequently, such interactions were primarily expressed as visual attention towards the interventions, and thus best evaluated through mobile eye-tracking (Figure 11).



Figure 10
Observations of passenger's interactions with the coloured circles on the platform floor.

PHOTO: CECILIE B. CHRISTENSEN AND ANDREA V. H. BUENO.

The main learnings came from understanding how the interventions did *not* work, and what else made a difference for passengers' movements and experience on the platform. The very process of designing, placing and analysing the workings of the design interventions contributed to understanding the platform space not only as a two-dimensional surface, but as overlapping "volumes" with a temporal dimension as well. Further, it was found that the existing setting seemed to matter more than the interventions, especially the presence of the platform escalators that disturb a full overview and circulation on the platform.



Also, social aspects such as norms and whether travelling alone or not, as well as personal motivation and embodied abilities mattered for passengers' movements on the platform. The interventions did, however, make a difference for passengers' *experience* on the platform, catching visual attention and adding some colour that contributed to a pleasant experience in most cases.

Overall, the placement of design interventions and the evaluation of passengers' responses (and lack thereof) contributed to produce understandings of mobile situations in the Metro that can ultimately inform the design of the future Metro as 'a good transit space'.

Becoming a passenger

Andrea Victoria Hernandez Bueno's PhD project investigated and explored a nuanced understanding of the situational passenger experience and airport design during the process of becoming a passenger in Copenhagen Airport as a case (Bueno, 2021). This means understanding passengers' micro-practices on the move and the way they feel and make sense of the airport's built environment in specific mobile situations. Such understanding of the passenger experience was used to inform and develop airport design principles for decision-making for the airport.²

The use of design interventions was part of a pragmatic and mixed-methods methodology, cf. note 1. The purpose of the implementation of the design interventions was threefold. First, as a mode of site analysis and mapping (finding challenges and potentials), to select the areas of focus

Figure 11
Snapshots taken from the eye-tracking video recordings showing passengers visually interacting with the light interventions.

ILLUSTRATIONS: CECILIE B. CHRISTENSEN

² This PhD is part of Airport City Futures research project, which studies Copenhagen Airport from 360 degrees (see Lassen et al., 2017).

(Figure 12). Second, to tackle specific design issues of the airport spaces in terms of wayfinding and legibility of areas, i.e., how easy it is to navigate and make sense of its spaces, efficient and safe organization, and distribution of flows. Third, as a form of exploration for design research and the airport space by provoking and altering situations.



The design interventions were implemented in two selected areas of the airport during peak seasons in terms of passenger numbers: the last week of August 2018 (end of holiday season) and first week of September 2018 (start of regular and business season). The first area selected was *the exit to the baggage claim of Terminal 3* on the airside (the secured area of the airport) (Figure 13) and the second one was *the Meet and Greet area* on the landside (the public area of the airport) of Terminal 3 (Figure 14).

The exit to the baggage claim presented problems of wayfinding and legibility. According to preliminary observations of the area, some passengers had difficulties finding the exit to the baggage claim, and hence had a negative and confusing experience. The Meet and Greet area was renovated over the course of the PhD project to optimize the flow distribution of passengers arriving and those departing that share the same level in this Terminal. After that renovation, the area presented problems with spatial legibility, wayfinding and organization of people and passenger flows. For example, some passengers arriving had difficulties finding the direction to the metro and train stations, and meeters and greeters usually wait in areas of flows or corridors interrupting passengers' flows, disrupting the emergency exits.

Figure 12
Site analysis of landside areas observed at the airport in 2017.

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Figure 13
The Exit to the baggage claim in the
airside area of the Terminal 3 of the
Copenhagen Airport.

PHOTO: ANDREA V. HERNANDEZ BUENO



Figure 14
The Meet and Greet area on the land-
side of Terminal 3 of the Copenhagen
Airport.

PHOTO: ANDREA V. HERNANDEZ BUENO

Two types of design interventions were installed in each area, respectively. They consisted of physical interventions and dynamic light projections on the floor and ceiling of the areas. In the exit to the baggage claim, a lighted balloon was hung from the ceiling with two types of dynamic light projections on the floor and ceiling of the corridor were installed where the main access to the baggage claim is located (Figure 15). The idea with these interventions was to create a *spatial landmark* of this area and for creating identity and wayfinding, since it works as a node of distribution of flows in a horizontal and vertical level, affords *invitations* to pause and look up and *experiential wayfaring*, by changing the atmospheres of the area with the use of warm and cold light projections (Bueno, 2021, p. 141). In other words, the idea was to respond to both the design challenges of the areas in terms of wayfinding, as well as to the research explorations in terms of exploring and augmenting the human experience of being at the airport, by providing and inviting different sensorial experiences.

In the meet and greet area, two lighted columns (cylindrical metal structures wrapped with translucent fabric and lighted from inside) were installed around two existing columns to define the arrival area (the “portal” to the city) for the passengers arriving and the meeters and greeters waiting for their relatives (Figure 16). Furthermore, dynamic light projections were installed on the floor of the waiting areas to “mark” the areas, and therefore attract people (meeters and greeters) to wait there, creating a different experience and atmosphere while waiting.



Figure 15
Design interventions at the exit to baggage claim in Terminal 3 of Copenhagen Airport: animated projections on the ceiling and floor and lighted balloon.

PHOTO: ANDREA V. HERNANDEZ BUENO



During the observations and analyses of data before and during the implementation of design interventions, it was noticed that the interventions did not change the passengers’ and people’s practices and movements in either space. In the exit to the baggage claim, the only change observed was that the airport authorities installed big advertisements around the elevator. As such, it seems the interventions were enhancing the commercial value of this area (Bueno, 2020).

Figure 16
Design interventions in the meet and greet area: a) lighted columns to frame the arrival area, and b) animated projections on the floor in the waiting area.

PHOTO: ANDREA V. HERNANDEZ BUENO

In the meet and greet area it was observed that some meeters and greeters, mostly kids, noticed the light projections on the floor of the waiting areas (Figure 17). In addition, according to the thermal camera's data analysis, the light projections on the floor seemed to have an influence on people's waiting practices, since more people were counted waiting there during the implementation of the design interventions than the week without interventions. Nevertheless, they did not prevent people from waiting in corridors or areas that block the flow of people. The interventions *failed* to "solve" the design, safety and operational challenges of the area in terms of people's practices and wayfinding, but they influenced the atmosphere of the waiting and flow areas. Overall, the design interventions served as a mode of situational mappings and communication with the passengers and airport authorities (Bueno, 2020, p. 17; Bueno, 2021, p. 251).



Figure 17
Passengers noticing the animated light
projections on the floors.

PHOTO: ANDREA V. H. BUENO

5. Design interventions – Potentials and challenges

With a point of departure in the descriptions of how design interventions were applied in the three respective PhD projects, this chapter presents a critical discussion of potentials and challenges in using design interventions, as part of a research-by-design approach to create design-based research knowledge. The chapter is structured according to the three aspects: "Projecting futures", "Material and embodied engagement" and "Forming new understandings", thereby linking to the state-of-the-art chapter and the presented model.

Projecting futures

By mapping the site and urban space under study, as well as designing and making the design intervention, the researcher/designer is engaging with what the site potentially could become, which eventually ends up as a comment on what it is today. This part of the process engages

with the tacit knowledge that comes from engaging in the research process as a designer, and involves a “different” kind of knowing, an informed experiment, a trying out without necessarily knowing the “right” answer beforehand. It is through the design process and the act of designing that contextual parameters from the specific urban space reveal themselves and give priority to the designer/researcher.

For instance, in Aarhus, the sensual effect of the numerous cars and buses going through Banegårdspladsen was intimately known beforehand, and the idea of working with sensory effects for the design intervention were brought into the project from the author’s theoretical point of departure. But the proposal of the carpet structure, and hence the name and the framing of the experiment, were invented during the “projecting future” phase. And, by projecting the idea of having an intense sensual carpet structure invading Banegårdspladsen, the lack of sensual character to the current Banegårdspladsen became even more obvious.

In the case of the Copenhagen Airport, the vast landscape and complexity in terms of scale and space required an extensive process of *in situ* observations and architectural mappings in order to understand the existing challenges and potentials, and consequently narrow the areas of focus and being able to project possible futures.

Challenges in this part of the process revolve around how to translate initial understandings and observations of a site to design interventions to be placed in-situ, and how to define the purpose and design criteria/parameters of the interventions. As researchers, it feels counterintuitive to place design interventions on site that are not meticulously considered down to the last detail, well-argued and with a consistent theoretical framework to back it up before execution. And as a designer, it can feel counterintuitive to place a design intervention in-situ that is not necessarily supposed to solve a concrete problem, to be a well-studied solution as the result of an iterative design process, but instead figure as a question or a potential answer. Both aspects relate to accepting uncertainty and applying the design interventions exactly to see what might happen. This also points to the value of the design interventions as an act of doing something, exactly intervening in a very material sense as a tool for gaining new insights and producing knowledge.

As such, all authors found that even though they would have liked to spend more time preparing the studies and building a well-defined theoretical framework before placing their interventions in-situ, they could not have predicted the understandings and learnings that actually came from placing the design interventions anyway. On the contrary, while all authors did have a rough theoretical outline before placing the design interventions, the understandings and knowledge gained from analysing the interventions helped shape the theoretical framework to the form presented in their respective PhD dissertations.

Material and embodied engagement

The use of interventions relates specifically to spatial design and to studying issues of design/use, i.e., how users/people/citizens respond to the placed interventions in terms of their practices and actions, and eventually also their experience of the placed design interventions. The design intervention and the urban installation can reveal a nuanced perspective on the effects of the changes on urban space. The very materialization of a design artefact and the installation of it has the potential to engage users and citizens and, in this way, invite embodied responses, but not necessarily cognitive and verbal responses.

This was especially so for the urban carpet with its wooden surface that responded with both smell and sound to the flows of wind and people passing. But also, the foil on the metro platform floor invited embodied responses from Metro passengers in jumping and playing on the coloured circles or in walking down the zebra stripes. Also, the light on the floor at the exit from the baggage claim in the airport invited responses from people waiting for their loved ones to return from their journey. These are explorations of human dimensions and sensorial experiences. Through design interventions, we are not only provoking situations based on functional rationalities but also enhancing and augmenting sensorial experiences, the meaning of places and the fact that we are humans inhabiting urban spaces.

The placement of design interventions also invites empirical engagement on the part of the researcher. In the case of the Metro, the two iterations of placing design interventions invited empirical engagement with the physical setting of the platform space in a very pragmatic sense. Ultimately, the design interventions contributed to understanding how the platform is not one uniform space. Rather, it is characterised by a high degree of spatial-material complexity, and the platform cannot be grasped in its entirety from any one point. In this way, engaging as a designer helped produce research understandings of the role of the spatial configuration vis-à-vis the way the design interventions engaged passengers and produced multisensory and affective responses.

The experience of placing the carpet on Banegårdspladsen in Aarhus, revealed something about the cycles of urban life taking place there. Placing the design intervention started in the evening where people were leaving work to go home, followed by people going out to restaurants or bars. They eventually returned home later in the evening, only to be replaced by people going out at night. In the morning people started going to work again, and the cycle would start over. People from various parts of the cycle engaged with us as we installed the carpet; through them different aspects of urban life taking place there revealed themselves. This experience had an impact on how the site was understood as more than a space for mass transportation but as an urban space with activities taking place at all hours.

The other side of the coin is how the aspect of material and embodied engagement, augmented by the use of design interventions, relates to the practical limitations involved in placing the interventions, something all of the three authors encountered. Such practical limitations are linked to how design interventions sometimes require extensive resources (materials, time, equipment) and coordination/collaboration with external parties, organizations and authorities.

In the case with the Metro, the interventions would not have been possible without the collaboration of the Copenhagen Metro, their funding and additional external companies that aided with making and installing the design interventions. Other practicalities to be considered were how the interventions had to be installed at night to minimise the interruption of the Metro service. However, as accounted for in the above, the resources and time spent are repaid through the empirical engagement and the invaluable understandings that this brings.

In the Copenhagen Airport, security and safety regulations and the commercial and operational requirements greatly affected the process of exploration and implementation of design interventions for three reasons. First, it was a time-consuming process and therefore it was not possible to implement several iterations of design interventions as intended within the time span of the project. Second, preliminary design iterations had to be discarded for fear of interrupting the passenger flows, operational processes and renovations planned to be implemented by the airport during the time and in some areas selected by the researcher to install the interventions. Third, the process of installation of the interventions was another challenge at the airport. This had to take place during the airport working hours. Therefore, the design interventions had to be installed and coordinated outside of peak hours, with regard to passengers' flows.

Embedded in these examples lies a challenge to balance the practical constraints involved in placing in-situ design interventions, as mentioned above, with the freedom to try out and explore what *could* be, to go beyond what *is* in the present. As such, it requires some degree of flexibility, involvement of authorities and collaboration partners to materialise interventions.

Forming new understandings

All the authors encountered challenges regarding how to evaluate the design interventions, which conclusions, and which questions they *could* answer or what methodological limitations they revealed. This further relates to the character of the object of study. Since we are studying urban situations in “the laboratory of the real world” rather than in a controlled laboratory setting as a classic comparative before-and-after study, the “effects” of the interventions also need to be evaluated

differently. The laboratory of the real world is messy, and rather than solving problems as “design consultants”, we were getting closer to the *real* problems.

As such, the difficulty in evaluating the design interventions relate to deciding which effects were valuable enough as “answers”, as observations and as findings. This also points back to the first parts of the model, the purpose of the interventions and the expectations of what they should do. Should they completely alter the movements of passengers and pedestrians? Or is it “enough” that they notice them, that they catch the attention of people? What we found was that they were good at highlighting embodied and sensorial interactions with the urban spaces in question, in this way revealing unintended effects and enabling unexpected answers and understandings of those spaces, rather than linearly solving problems.

In the case of the urban carpet, it was expected that its smell would evoke reactions of passers-by, but instead it seemed that its xylophone-like sounds were equally effective. However, other uncertainties in the actual findings from this installation are critical. What effect did the festival atmosphere have on the perception of the installation? What was not included in the conclusions by using observations rather than interviews with the pedestrians? And, how influential were the legislative and safety regulations on the outcome of the study?

In the case of the Metro, the interventions invited unexpected uses such as play and acting as a device for gathering kindergarten children. However, the interventions did not make an unequivocal and clear difference for the movements and placements of passengers nor “solve” capacity issues and crowding on the platform. This then points to the affordances of the existing physical setting. Conversely, the design interventions, if they were noticed, did make a difference for the *experience* and visual attention of riding the Metro, mostly in a positive way. They were appreciated for symbolic meanings and for bringing warmth, colour and playfulness into the otherwise “grey and boring” Metro setting. In this way they showed atmospheric qualities and potentials to work in what the author terms “cracks of stillness”, when passengers come to a halt on the platform, e.g., while waiting for the train. This can further be seen as public space qualities, allowing passengers to attach significance and meaning to the interventions over time.

In the airport, the design interventions increased an understanding of how the commercial atmospheres of the airport are an influential and important factor that affects the visibility and the effects of the design interventions. They also increased an understanding of the fast changeability and hybridity of airport spaces, in terms of space and flows, and the airport design process. For instance, how the organization

influenced the design decisions and what was possible to do within the airport framework, since different negotiations and permissions were necessary to install the interventions and hence comply with security and operational aspects. In addition, the evaluation of the effects of the design interventions provided a challenge to give both concrete answers to the airport in terms of design “solutions” and design knowledge for the research, in other words to have a clear separation between research and design findings. The findings were translated into design principles, strategies and methods for the airport as tools to explore design concepts at the airport, rather than fixed solutions due to the airport’s changeable and unpredictable nature.

The above accounts point to how, across all three cases, the design interventions worked in subtle ways, and the interesting answers came from understanding the more subtle effects of the interventions. This underlines how the evaluation and analysis requires being open to unintended effects and unexpected answers, attuning itself to more subtle and sensorial effects. All three authors found that the analysis was more about finding patterns in messiness and accepting the messiness of the research process as a basic precondition, comparable to design processes.

This further requires being able to re-calibrate one’s own understanding of the object of study, the urban space in question and the purpose and intentions of the design interventions placed there, while *in* the process. That is to say, being open to what the interventions actually *do* and what they show. As such, teasing out learnings from placing the design interventions was a balance between having a certain direction and goal with the interventions, having taken a point of departure in observations and considerations regarding the site and their expression, location etc., on the one hand, and on the other hand to still be open to alternative and unexpected answers, open to changing direction according to their effects.

6. Conclusions: Design interventions as tools for design knowledge

The model presented in this article presents a first attempt a synthesizing our experiences from doing design interventions together with insights from state-of-the-art literature. Thus, the model presents a set of notions that potentially can enable and guide other design researchers in their venture with design interventions as part of a research-by-design approach.

Design interventions ask questions of what *could* be, in response to what currently *is*. The examples accounted for here point to explorations of urban situations through designed artefacts related to human embodied

dimensions and sensorial experiences (atmospheres, smells, tactile and haptic senses, materialities), as well as the importance of such. We did not only provoke situations based on functional rationalities to solve problems but also to enhance human realities in urban spaces and the fact that “design” can help us to augment embodied, sensorial and material experiences in urban spaces.

As such, the design interventions projected a future of how the urban spaces of the studies could invite embodied and sensorial involvement of users with the material context of the spaces they were inhabiting and moving through. What the studies presented in this paper suggest is that design interventions extend an invitation, engaging the body’s multi-sensorial responses.

Furthermore, the design interventions raise an awareness of how urban spaces are essentially *designed*, i.e., the result of a design process with design intentions and decisions, and the opportunities of engaging with this design. Design interventions connect to contemporary understandings of “the urban” – the city as a process, always in the state of becoming, always in flux (Jacobs, 1961; Amin and Thrift, 2002, p. 8). As such, design interventions invite a process-oriented approach to urban design research, which aligns with such contemporary understandings of the city. Applying design interventions in urban design research allow researchers to form new understandings, which might not have been possible to gain without using design interventions as a tool. In this way, design interventions can be understood as part of a more explorative and open-ended research process as advocated for in non-representational theory (Thrift, 2007). Ultimately, design interventions allow researchers to engage with urban spaces and what they actually *do*, how they affect users in sensorial and embodied sense, which in turn are changeable effects and what makes the city a process rather than a static entity.

Imagine that you moved through the three previously visited urban spaces. Maybe you noticed the design interventions, and maybe they made you wonder why they were placed there. Maybe they sparked your curiosity, invited you to engage with the wooden carpet at the train station square, the light on the walls of the Metro or the light on the floor surface in the airport. Probably, they did not interrupt your movements, you could flow unhindered past them, not needing to stop. Maybe you thought they were a bit out-of-place, not what one would usually find in such a space. And *if* they made you wonder, they succeeded in engaging you. Understanding more about the situations that led to that engagement might tell us something important about how to design good urban spaces in the future. And, design interventions, as this article would argue, are a potentially good tool to do so.

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