# Visual guidelines for climate-responsive urban design

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## Abstract

Communication of climate-responsive urban design guidelines is becoming increasingly relevant in the light of climate adaptation challenges in cities. Widespread uptake in practice of such guidelines can be promoted by visualizations of the principles on which they are based. The “Really cooling water bodies in cities” research project developed and tested the required knowledge on visual communication. Evidence-based design guidelines assisting designers with creating cooler urban water environments were developed and communicated with 3D animations. The animations were shaped according to three core theoretical criteria about visual representations: “visual clarity”, “trust” and “interest”. We assessed in how far these criteria were met in an inquiry with design professionals, the target group of the design guidelines. The article concludes with recommendations for developing visual design guidelines in climate-responsive urban design: to weigh the level of detail, components and balance between site-specificity/abstraction (“visual clarity”); to make microclimatic processes visible without distorting them (“trust”); and to keep timing short and visual attractiveness high (“interest”). It is argued that taking these aspects into account and setting a clear correspondence between theoretical concepts, representation objectives and options, can largely benefit visual design guidelines communicating climate-responsive urban design knowledge.



## Keywords

Climate-responsive design; design guideline; visualisation; microclimate; waterbodies

## 1. Introduction

Climate change is expected to lead to an increasing number of extreme events, which forces cities to adapt to now, starting with raising the levels of awareness of the professions who design urban environments. This requires measures backed by evidence about meteorological factors (Nouri et al., 2018). But these measures also need to ensure liveability within the built environment, which involves consideration social aspects and amenities (Stanislav & Chin, 2019) as well. Landscape architects and urban designers play a vital role in improving urban areas as “they intervene physically at various scales in the landscapes where people live, commute, and recreate” (Sheppard, 2015). Evidence-based design knowledge can assist designers with addressing the challenges they face and with developing better informed design solutions. However, “time constraints or simply the nature of assignments can make it hard for design professionals to find relevant evidence that can inform their designs” (Lenzholzer, Nijhuis, & Cortesão, 2018). Providing designers with applicable evidence-based design knowledge can help circumventing time constraints in practice and, thus, bridging research and practice on climate-responsive design. Design guidelines are expected to offer transferable knowledge that “works beyond a specific case to a more generalisable set of situations” (Prominski, 2016). Amongst different types of guidelines, visual design guidelines can efficiently provide applicable evidence-based design knowledge to design professionals because designers tend to support their generative thinking on visual notations (Stappers, 2007).

In climate-responsive urban design, visual design guidelines can help to better understand microclimatic phenomena because “the complex invisible phenomenon of microclimate” (Lenzholzer & Koh, 2010) is translated into intelligible visual information. We expect that visual guidelines on climate-responsive design can help prompting action on climate adaptation by depicting the invisible microclimate phenomena and design knowledge on how to improve it.

Visual communication in climate-responsive design has been addressed in previous research (Cortesão, Alves, & Raaphorst, 2020; Lenzholzer, 2015; Munnik, 2018) as well as the need to develop visual design guidelines to inform landscape architecture and urban design practice (Klemm, 2018; Lenzholzer et al., 2018; van den Brink & Bruns, 2012; Lenzholzer, 2010).

In this context, this article addresses the key issues in developing visual design guidelines communicating climate-responsive urban design knowledge that is applicable in practice. To this end, the design guidelines developed in the "Really cooling water bodies in cities" (REALCOOL) research project are presented and analysed. REALCOOL looked into potential cooling effects of small urban water bodies. Based on the observed negligible cooling effects from water itself (Jacobs et al., 2020), REALCOOL developed visual design guidelines for creating cooler urban water environments. The REALCOOL design guidelines are prototypical representations of common urban water environments with the design interventions implemented. They are visualized as 3D animations and, due to their representativeness, they can act as generic design guidelines assisting designers with creating cooler urban water environments (Cortesão et al., 2019).

This article shows how visual design guidelines transferring knowledge from research to practice can be developed, visualized, and evaluated. The methodological approach herein presented offers an illustration of how academia can contribute to prompt action on the adaptation of urban areas to climate change.

## 2. Translating theory into visual communication guidelines

In producing the REALCOOL visual guidelines, namely the 3D animations, three concepts of effective visual communication in relation to climate change proposed by Sheppard (2001, 2015) were taken into account: “visual clarity”, “trust” and “interest”. “Visual clarity” relates to making a message easily seen and understood (Sheppard, 2015); it deals with clearly communicating the details, components, and overall content of the visualisations (Sheppard, 2001). “Trust” refers to the honesty, balance and verifiability of representations (Sheppard, 2015). “Interest” deals with engaging and holding the interest of the audience yet without seeking to entertain or ‘dazzle’ (Sheppard, 2001), and trying to meet the typical communication needs of the target groups. For instance, visual communication should captivate audiences by referring to situations that are familiar for them.

The representations took into account three overarching aspects: (1) the overall purpose of the visualisations, i.e. to be replicable; (2) the need to communicate the complex topic of microclimate in simple terms; and (3) the software used, its potentials and limitations, for producing the visualisations. Bearing this in mind, the three concepts presented above were translated into objectives for the REALCOOL design guidelines:

- “Visual clarity”. The 3D animations should be simple and clear, and the cooling effects of the implemented design guidelines should be easy to understand. We omitted unnecessary details; used simplified geometrical shapes, patterns and solid fills; and included infographics while reducing texts to a minimum and avoiding professional jargon.
- “Trust”. The abstracted urban environments that underlie the 3D animations should be verifiable, i.e. represent the physical urban environments accurately

yet without referring to any specific location or situation. The representation of biometeorological effects should be honest, as in making them visible while preventing exaggeration. We represented general spatial configurations that designers could relate to and avoided imitating reality. We also avoided overstating thermal environments as to prevent wrong expectations.

- “Interest”. To meet the needs of the target group of urban designers, landscape architects and related professions, the 3D animations should be short and to-the-point, considering the time constraints often encountered in practice. They should adopt an appealing style of visualisation, i.e. a layout that is immediately recognized by the target group of landscape architects and urban designers.

The specific representation options for the 3D animations are summarised in Table 1, by reference to the theoretical concepts and representation objectives employed.

| **Concept** | **Representation objective** | **Representation options** |
|---|---|---|
| 1.“Visual clarity” | *Simple* and *clear* visuals | • omitting details of design elements<br>• omitting all accessory textual and/or graphic information<br>• representing organic elements through stylised geometrical shapes (trees) or simplified patterns (grass)<br>• representing materials through solid fills<br>• using neutral colours |
| | *Easily understandable* cooling design guidelines | • using infographics<br>• reducing texts to a minimum<br>• avoiding professional jargon |
| 2.“Trust” | *Verifiable* abstracted urban environments | • representing spatial configurations that designers could relate to, yet omitting any indication of place or situation |
| | *Honest representation* of biometeorological effects | • using symbols to represent effects instead of imitating reality<br>• preventing to overstate thermal environments |
| 3.“Interest” | *Appropriate timing* | • setting timing long enough to properly communicate but short enough to provide a swift answer |
| | *Appealing visuals* | • applying a neutral/sober style of visualisation<br>• introducing movement effects<br>• introducing sound effects |

Table 1. Representation objectives and options for the REALCOOL 3D animations.

Based on the concepts employed for communicating our design guidelines, we formulated the following research question: did the representation options made for the REALCOOL 3D animations result in visual design guidelines effectively communicating climate-responsive urban design knowledge to practice?

## 3. Materials and Methods

### 3.1. Producing the prototypes

The REALCOOL prototypes were developed with a Research Through Design (RTD) method. This is an iterative process in which designing and testing alternate. The process is guided by clear research questions, where the former design iteration and its evaluations inform the subsequent until new knowledge is achieved (Lenzholzer, Duchhart, & Koh, 2013; Nijhuis & Bobbink, 2012). REALCOOL comprised six RTD iterations (Figure 1). In each iteration, design options were developed and tested with different methods. Testing methods included experts judgements, micrometeorological simulations with the Envi-met model, design workshops where stakeholders assessed the applicability of the design solutions, an online inquiry to the Dutch population, and a 'reality check' that assessed the performance of the design solutions in real sites and assignments.

The design solutions were projected upon spatial reference situations that we termed as "testbeds". These testbeds referred to typical layouts of Dutch urban water bodies identified during a preparatory stage: three canals, two wide canals, two ditches and one pond. East-West and North-South orientations were taken into account.

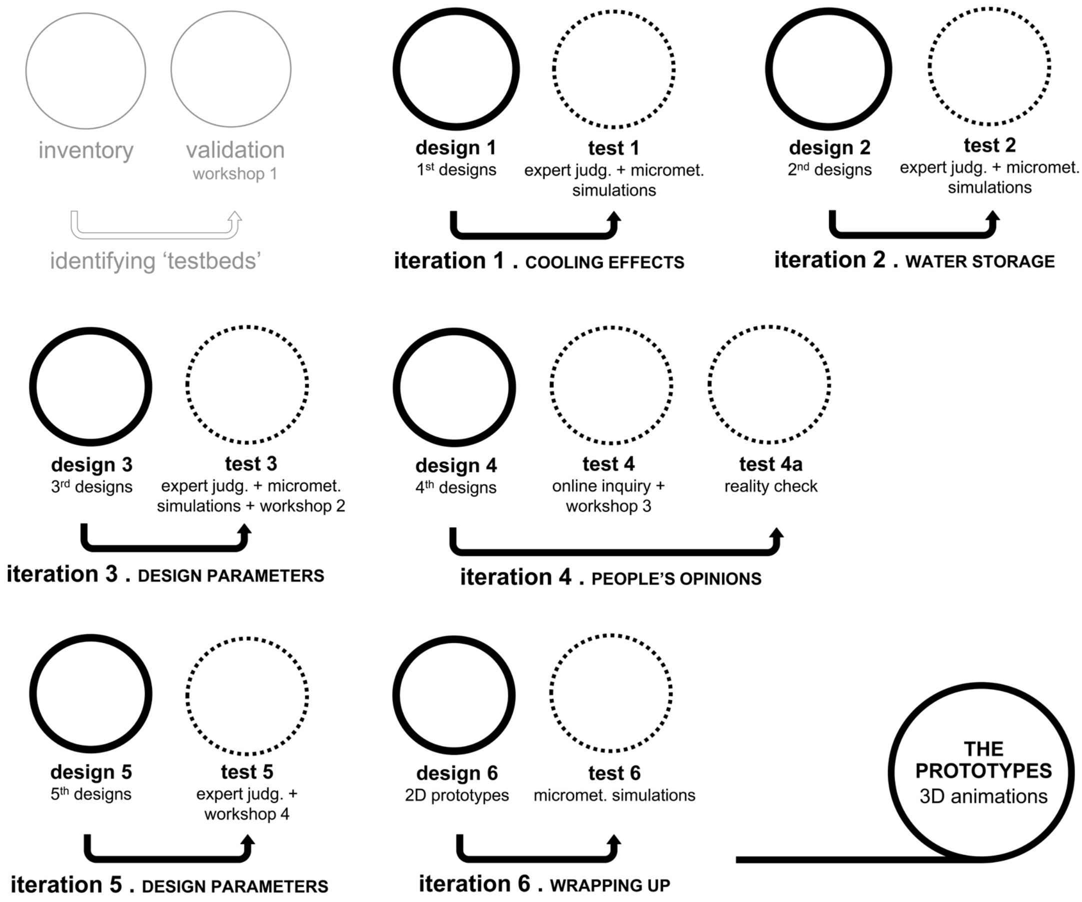


Figure 1. The REALCOOL RTD methodology. The solid-lined circles refer to design stages and the dot-lined circles to test stages.

The RTD iterations gave structure to the designing process and increasingly optimized evidence-based design solutions. While the first five iterations dealt with developing evidence in the microclimatological effects of the design options, iteration 6 synthesised it by setting the REALCOOL final design solutions, hereafter referred to as 2D prototypes (Figure 2), and transforming them into 3D animations (Figure 4). These 3D animations are the REALCOOL final design guidelines and are freely available at: http://climatelier.net/projects/research/realcool-really-cooling-water-bodies-in-cities/.

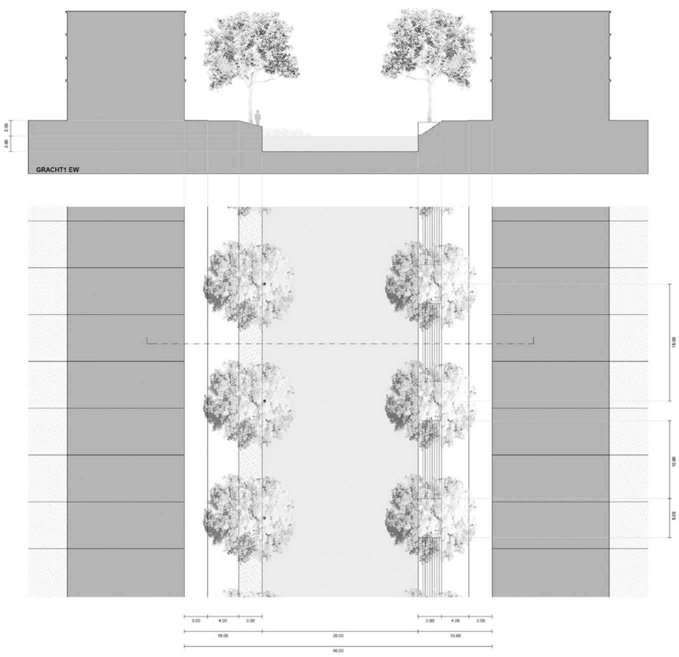


Figure 2. A REALCOOL 2D prototype.

To illustrate how we developed the transferable guidelines throughout the RTD process, we explain the process for one testbed: Canal 1 east-west orientation (Figure 3a). Iteration 1 focused on achieving maximum cooling effects by adding as much vegetation as possible onto the testbed (Figure 3a and 3b). The design hypothesis was that more vegetation leads to more cooling (design 1), which was explored through sketches, 2D drawings, and physical scale models (Figure 3b). Testing (test 1 in Figure 1) with the micrometeorological model showed that more vegetation lead to cooling but it also that the large number of trees and shrubs locally increased the PET (Physiological Equivalent Temperature; Höppe, 1999) by blocking wind.

In iteration 2, the number of trees was reduced, their shape diversified, and shrubs were excluded in order to enable wind flow. Design 2 further dealt with the hypothesis that reshaping quays could significantly increase the rainwater storage capacity of the testbed. The wall-like quays were thus replaced by a slope (north side) and stairs (south side) towards the water. In order to increase cooling by evaporation the slope introduced was made green. In test 2, the micrometeorological effects were assessed by expert judgement and Envi-met modelling.

After refining the designs according to the outcomes of test 2, in iteration 3 the designs aimed at water storage and cooling were developed with typical aspects encountered in design practice (design 3): aesthetics, function, costs, maintenance and health effects. The incorporation of these aspects would enhance the feasibility of the design guidelines. For instance, the angle of the green slope was thought as to enable maintenance procedures. Test 3 checked the resulting cooling effects. Once these were confirmed, the designs were discussed with the stakeholders.

Iteration 4 dealt with gathering the opinion of citizens on the proposed spatial environments (test 4) (Figure 3d), and of practitioners on the applicability of the interim guidelines comprised in the 2D prototypes (test 4a). The feedback was predominantly positive, but design refinements were proposed.

Iteration 5 further refined the 2D prototype with practice parameters (design 5), based on the outcomes of test 4. The resulting designs were tested through experts' judgements and with the stakeholders (test 5). The feedback obtained was incorporated in iteration 6 (design 6). The whole process was wrapped-up through a final design check and micrometeorological simulations (test 6).

At the end of this process, the 2D prototype for canal 1 east-west was made final (Figure 2). The following design guidelines for this water body type were retrieved: (1) keeping existing trees in place or introduce new ones with the same arrangement, to shade and enable wind flow; (2) introducing water mist in sunlit areas to cool down the air; (3) introducing green slopes and/or stairs towards the water to enhance cooling experiences (psychological and physiological) in direct connection to water. Finally, the 3D animation (Figure 4) was produced.

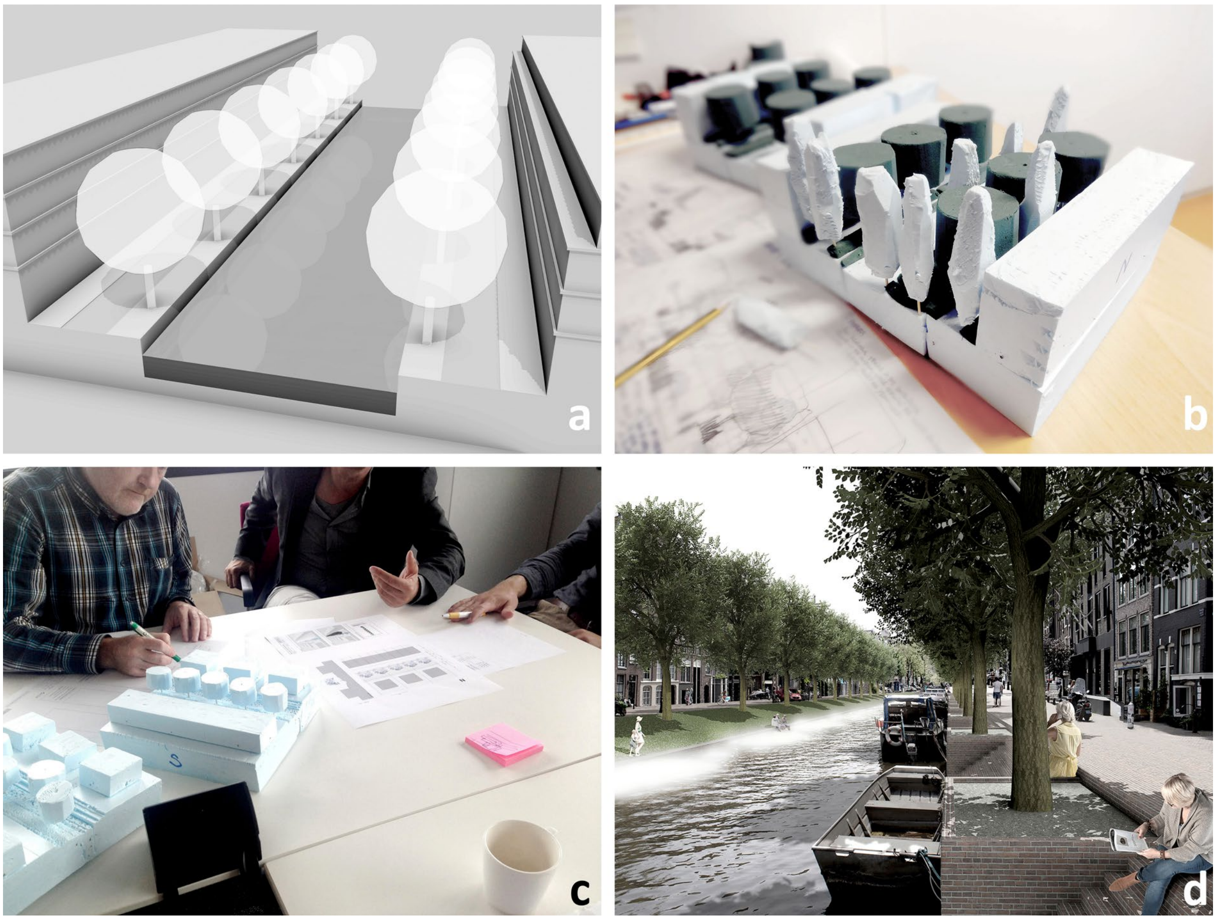


Figure 3. Some moments of the RTD process for prototype for Canal 1 east-west orientation. Image credits for image 3d: Lenné3D.

This example shows that producing the 3D animations involved four main steps:

- *Defining the 2D prototypes.* A round of last refinements to the 2D prototypes (design 6 on Figure 1) followed by micrometeorological simulations providing figures on the final cooling effects (test 6).

- *Creating the 3D scenes*. Eye-level walkthroughs anchoring all information to be communicated. These scenes were modelled with SketchUp Pro 2017 and rendered with Lenné3D's in-house software Biosphere3D.
- *Extracting the design guidelines*. Listing the design measures comprised in the 2D prototypes.
- *Embedding the design guidelines into the 3D scenes*. Setting the visual design guidelines. Infographics were used as some information had to be communicated textually (design measure) and numerically (dimensions) within the animations. 3D scenes and infographics were adjusted to one another, for example, through the position and colour of graphic elements.

The 3D animations were developed according to the following storyline:

1. *Common situation* (Figure 4a). Averaged spatial configuration and dimensions of each urban water body type.
2. *Cooling design guidelines* (Figure 4b). The design measures comprised in the final 2D prototypes, accounting for both climate-responsive and common practice parameters.
3. *Biometeorological effects* (Figure 4c). The broad effects on shading, ventilation and vaporisation expected from applying the design guidelines.
4. *Cooling effects* (Figure 4d). Quantification of the cooling expected, expressed as PET, according to the final Envi-met simulations (test 6). PET values are indicated over the coolest areas in order to inform on their spatial distribution.
5. *Accessibility to water* (Figure 4e). Additional design measures intended to increase rainwater storage capacity and to enhance cooling experiences by providing direct access to water.

In this storyline, timing played an overarching role as it related to the sum of its parts/moments. All other representation objectives of “visual clarity”, “trust” and “interest” were employed in each part of the storyline with slightly different emphasis (e.g. part 1: “interest”; part 2 and 4: “visual clarity”; part 3 and 4: “trust”).

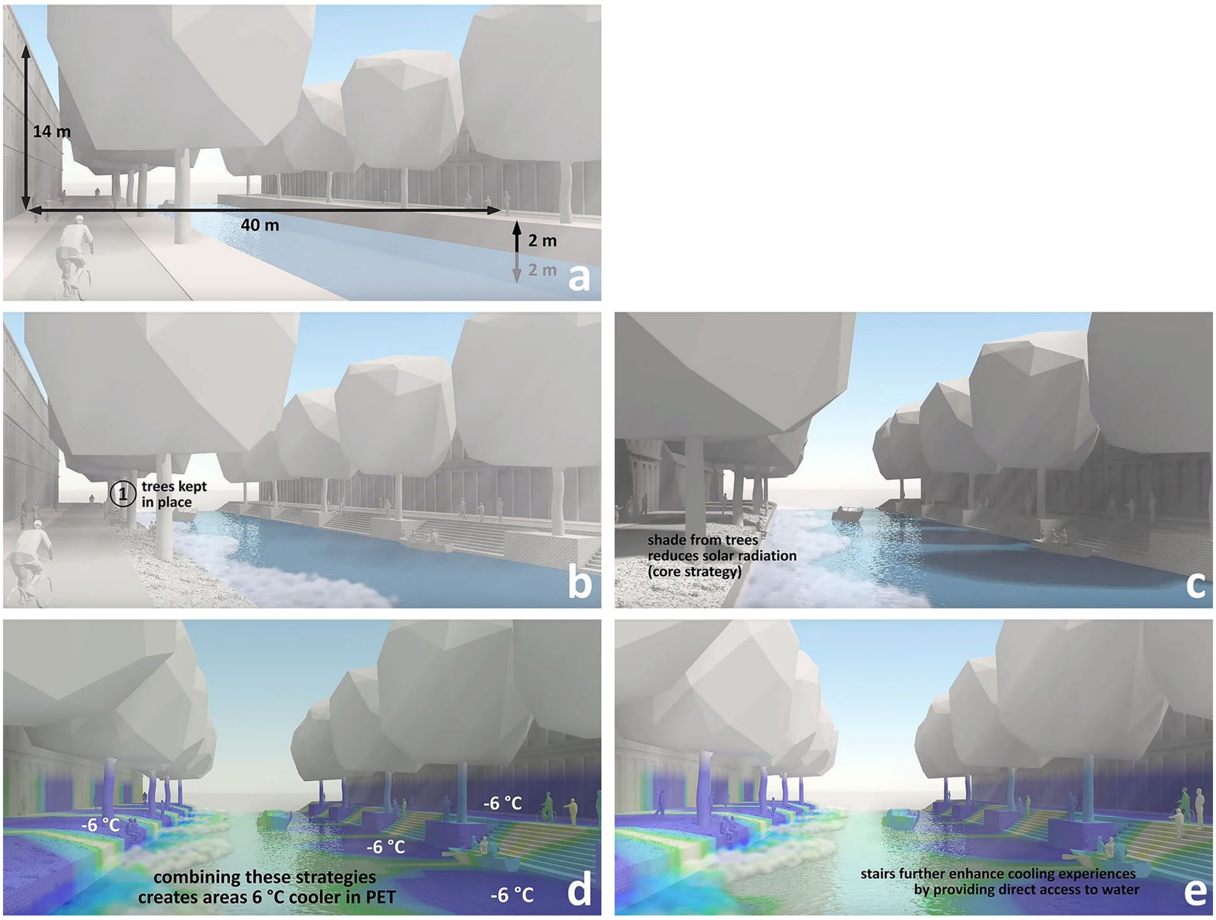


Figure 4. Snapshots of the five moments of the 3D animations’ storyline for prototype Canal 1 east-west orientation. Image credits: Lenné3D

## 3.2. Testing the applicability of the prototypes

To answer the main research question of this article (did the representation options made for the REALCOOL 3D animations result in visual design guidelines effectively communicating climate-responsive urban design knowledge to practice?), an online questionnaire was set up (Table 2). The target group consisted of landscape architects and urban designers and similar professions. Respondents were reached directly via email and LinkedIn posts and were invited to fill in the questionnaire and to share it.

The questionnaire structure and way of formulating the questions was based on literature (Albaum and Smith 2012; Gideon 2012; Manzo and Burke 2012) and built with the online tool Typeform. The online inquiry was prepared to be quick, clear and simple to the respondent. Six questions were formulated as close-ended statements. These statements directly reflect the theoretical concepts and the associated representation objectives (Table 1), with two statements per concept. The three concepts derived from the literature were not explicitly communicated in the questionnaire. However, their keywords were transposed into the statements in order to address the theoretical concepts. The language was kept simple and professional jargon was avoided as well as repetitiveness, bias and emotional contents. The respondents were asked to give their opinion on a seven-point Likert scale, ranging from “strongly agree” to “strongly disagree”. For votes on the disagreement side of the scale, optional open-ended questions were included for sharing what could have been different while developing the prototypes. The contents of the questionnaire are presented in Table 2, by reference to the theoretical concepts employed.

| **Theoretical concept** (not communicated) | **Statement** | **Answer** | **Optional question** |
|---|---|---|---|
| “Visual clarity” | 1. The animation visuals are *simple* and *clear*. | Likert scale:<br>strongly disagree<br>disagree<br>slightly disagree<br>neither disagree nor agree<br>slightly agree<br>agree<br>strongly agree | If the visuals are not clear, what should have been different? |
| | 2. The cooling design guidelines shown in the animations are *easy to understand*. | | If the guidelines are not easy to understand, what should have been different? |
| “Trust” | 3. The abstracted urban environments are *well represented*. | | If the animations do not represent the urban environments well, what should have been different? |

| | | | |
|---|---|---|---|
| | 4. The biometeorological effects are *represented realistically*. | | If the animations do not represent these processes realistically, what should have been different? |
| “Interest” | 5. The animations have the *right timing*. | | If timing is not good, what should be different? |
| | 6. The animations are *visually appealing*. | | If the animations are not visually attractive, what would you prefer? |

Table 2. Contents of the online questionnaire.

The questionnaire finished with two questions on interest in climate-responsive design and type of job. The former revealed if respondents were interested in climate adaptation (a “yes/no” answer possibility choice was offered). The latter showed if respondents were engaged with the type of design activities comprehended by the prototypes (a multiple-choice answer format was offered: “urban designer, landscape architect, urban planner, civil engineer, policy advisor, other”). The questionnaire was anonymous and confidential.

## 4. Results and Discussion

The online questionnaire was completed by 50 respondents: *target group* (80% of respondents), consisting of landscape architects (25) and urban designers (15); and *others* (20% of respondents), namely architects (4), civil engineers (3), urban planners (2) and policy advisors (1). This clustering of respondents was aimed at distinguishing the feedback of the target group from the feedback of other professionals. However, no substantial differences were observed between one and the other cluster, reason why they are not mentioned in the text below.

All respondents indicated to be interested in climate-responsive urban design. The overarching results obtained for each statement are summarised in Figure 5 and discussed below.

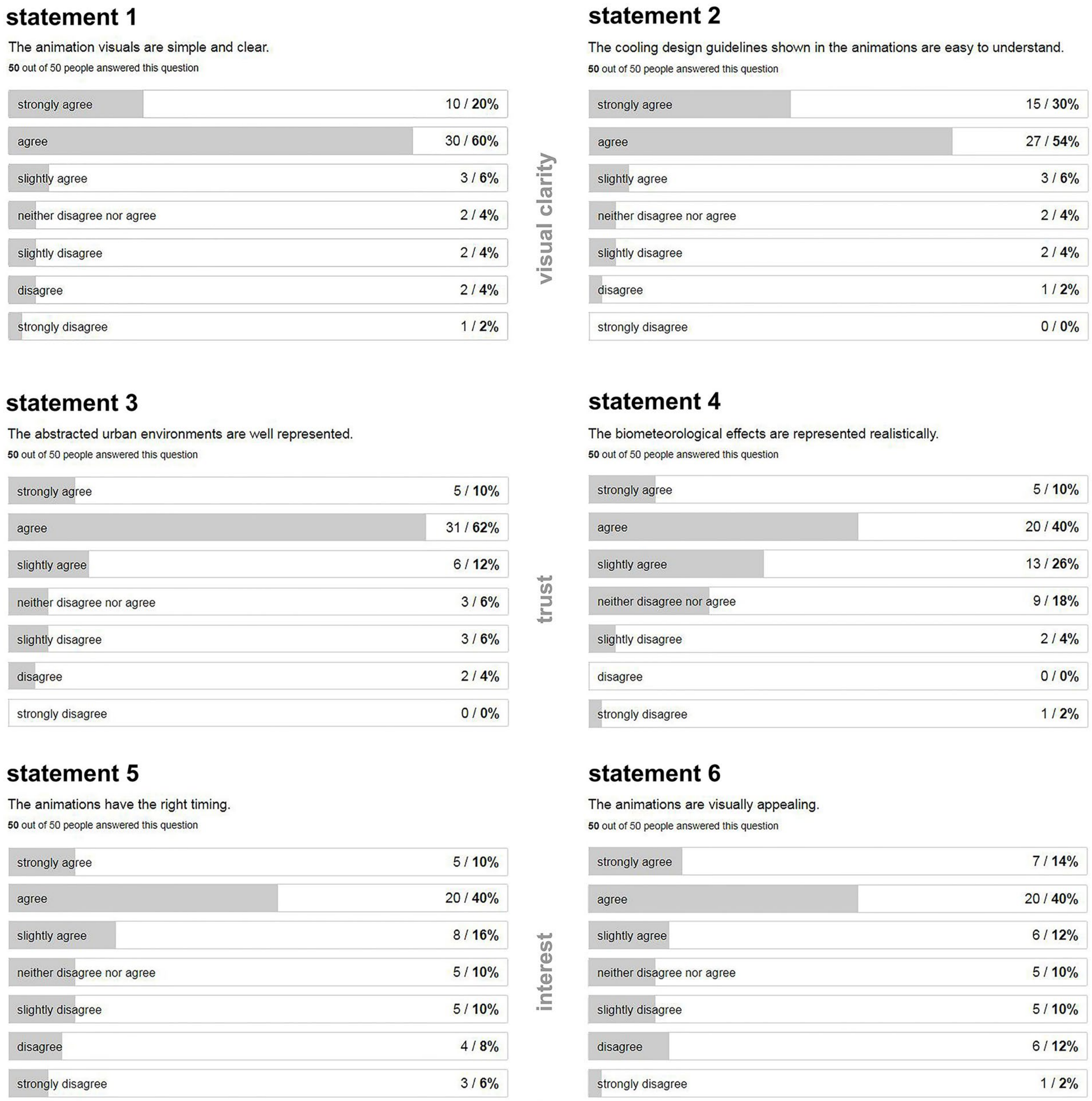


Figure 5. Results of the online questionnaire. Adapted from the output file generated with Typeform.

The results of the questionnaire show that most respondents agreed with the statements. The representation options around "visual clarity" gathered most agreement, followed by those for "trust" and for "interest". For disagreement and neutral votes, the feedback of respondents, as in the additional comments typed in for the open questions, included several different aspects from which we present the predominant ones.

4.1. Visual clarity

The results suggest that the representational options made on this concept were effective. Recalling Sheppard's (2001, 2015) definitions, the representation options on "visual clarity" seem to have made the REALCOOL design guidelines easily seen and understood. This is suggested mainly by the votes on statements 1 and 2: the animation visuals are simple and clear (statement 1) and the cooling design guidelines shown in the animations are easy to understand (statement 2).
As it can be observed in Figure 5, regarding the first statement, 86% of votes fall on the agreement side of the Likert scale. The feedback of respondents was that more detail and visual differentiation (e.g. contrast or colour) would have been beneficial. Statement 2 gathered 90% of agreement votes. However, some guidelines would be clearer by presenting more technical information (e.g. type of water mist nozzles). The feedback on statements 1 and 2 points out the challenges around finding the right compromise between site-specificity and abstraction. The REALCOOL design guidelines are applied over generic urban environments (the testbeds). This made deciding about the level of detail and conveying the overall content of the animations challenging: the guidelines had to be specific enough as to support the designing process but without being deterministic.
As Prominski (2016) argues, "design guidelines are neither totally specific nor completely universal and represent structured knowledge bundles at an intermediate level". Our findings suggest that this "intermediate level", i.e. the generic nature of the REALCOOL design guidelines, might have not been clear to all respondents. In

addition, it might have led to expectations regarding specific contents which were out of the scope of the project. The REALCOOL guidelines should be understood in light of the idea that “guidelines themselves are not designs; they only serve as an ‘enzyme’ which designers may use in the design process” (Prominski, 2016).

### 4.2. Trust

The results suggest that the representation options allowed addressing Sheppard’s (2015) conceptions around the honesty, balance and verifiability of representations properly. This is mainly supported by the votes obtained for statement 3, where 84% of respondents agree that the abstracted urban environments are well represented. Furthermore, statements 1 and 2 gather very much agreement, and statement 4 gathers general agreement although somewhat less than the previous statements.

The feedback on statement 3 pointed out again the need for more detail, as some respondents noted that the real urban environments are more diverse than the animations suggest. This feedback can be discussed in light of the arguments mentioned above for “visual clarity”: the generic nature of the REALCOOL guidelines. Omitting indication of place or situation was fundamental for the replicability of the guidelines. Possibly some respondents misunderstood it, which might have led to expectations for more detailed representations of the urban environments. No hint was given on what these details should entail.

The higher number of neutral votes for statement 4 is worth of note. Feedback was inconclusive since it was given by only two people. But the feedback on the disagreement votes revealed that: (1) some biometeorological effects needed further explanation; (2) the acronym PET should have been explained; and (3) shade and wind could have been represented in a more understandable way. The first two remarks may be interpreted in light of the arguments presented for “visual clarity”: the interviewees might have interpreted the sparse use of texts in the animations as a lack of information. The third remark can be interpreted through the idea that “visualization offers a method for seeing the unseen” (Lewis, Casello, & Groulx, 2012). In climate-responsive urban design, visualisations have to represent invisible and complex microclimatic processes without overstating a thermal environment. The honesty, balance and verifiability (Sheppard, 2015) of climate-responsive design representations are strongly dependent on the credibility with which the invisible is made visible.

Sheppard (2015) advocates that visualisations dealing with adaptation to climate change “should not exaggerate the effects of climate change, distort landscape features, or selectively omit key elements”. Building on this argument, in REALCOOL the representation of biometeorological effects was not supposed to be exaggerated (e.g. not cooler nor warmer than circumstances would probably be), not to distort features as to emphasize a given biometeorological effect (e.g. distorting a tree crown as to depict a more convenient shading pattern), and not to omit elements necessary to a full appreciation of the environment depicted. Yet, this might have not fulfilled the expectations of respondents, which might also explain the increase of neutral votes for statement 4. This suggests that the boundary between “visual clarity” and “trust” while communicating invisible microclimate phenomena may not be straightforward.

### 4.3. Interest

The results indicate that the animations have the right timing (statement 5) and are visually appealing (statement 6), in line with the recommendations by Sheppard

(2001) on engaging and holding the interest of the audience. However, the disagreement votes for these statements are also noticeable.

Statement 5 counts with 66% of agreement votes but disagreement votes increase to 24%. Respondents indicated that the animations “could be shorter” and “use a faster tempo”. This highlights the weight that time and demand on interaction have for observing 3D situations (Wergles & Muhar, 2009). The timing of the REALCOOL animations ended up in 1.19–2.08 minutes. This timing was the best compromise found between properly communicating the design guidelines in the shortest time possible. Yet, this seems to not have been short enough for some respondents.

Statement 6 also received 66% of agreement votes as well as an increase in the number of disagreement votes. The feedback was that: (1) the animations were too abstract, lacked atmosphere and detail; and (2) the animations could be more “photorealistic” and “naturalistic”. Again, the misunderstanding of the generic nature of the REALCOOL guidelines might explain these votes and feedback. But the 3D animations were meant to highlight the fundamental: cooling design guidelines and resulting biometeorological effects, in line with the idea of omitting and reducing unwanted detail “to a set of essential characteristics” (Bates-Brkljac, 2009).

Feedback also included that the animations could be more “colourful”, “inspiring” and to have “more distinction”. The difficulties and uncertainties around aesthetic values in landscape architecture can be called forth here. Etteger (2016) writes, “even though not everyone likes the same things, the other extreme situation – that each individual has a completely different taste – is certainly also not the case”. Based on this statement, we argue that visual representations will hardly ever please a whole target group. Instead, based on the mostly positive appreciations of the REALCOOL animations, we expect that more than their aesthetical appeal, the more tangible/relatable the design guidelines are to practitioners, the more chances created to their actual considering in practice.

## 5. Conclusions

Our results indicate that the representation options made for the REALCOOL 3D animations, based on the theoretical concepts employed, resulted in visual design guidelines effectively communicating climate-responsive urban design knowledge to practitioners. We would like to conclude with the implications of our outcomes and practical recommendations for climate-responsive urban design.

Methodologically, we argue that developing visual guidelines for climate-responsive urban design calls for an iterative RTD, where the correspondence between representation theoretical concepts, objectives and options is set up front. The iterative process allows to cumulatively develop and test this correspondence.

Visualizations may be assessed by target group and local stakeholders which can, for instance, be engaged as to validate the output of the research and provide recommendations for the improvement of a tool (Attia et al. 2019).

When online surveys are the choice, one may encounter lack of participation due to a trend for low response rates for Web-based surveys, and difficulties in reaching out to people and get them to participate (Manzo, 2012). This was the case for REALCOOL. The results from a larger sample, which would provide a more reliable database, was not possible to achieve. The online survey was closed after six months as no new answers were received, even after several reminders were sent.

Conceptually, we argue that the visualisations resulting from this process should be simple and comprehensible (“visual clarity”), reliable (“trust”) and attractive to practitioners (“interest”) and, thereby, confirm the recommendations of Sheppard

(2012), who developed these concepts for the visualization of climate change and not for climate adaptation. Irrespective the particular medium, personal taste or means at hand, visual design guidelines can better be developed at the “intermediate level” between site-specificity and abstraction. This is to give practitioners the flexibility to adapt them to particular circumstances and to their personal narratives, and to enable visual thinking, a typical design activity that “allows to ‘digest’ information in a rational and systematic way” (Nijhuis, Stolk and Jan Hoekstra, 2016). However, our findings suggest that the omission and synthesis of information targeted at this flexibility/replicability might be regarded by practitioners as lack of information.

Based on the lessons learnt in REALCOOL, our recommendations for developing visual design guidelines in climate-responsive urban design considering the three concepts employed are:

Visual clarity

- Climate-responsive visual guidelines should pay extra care while weighing the *level of detail and components* included, in order to clearly communicate a still not widespread urban design practice.
- It is crucial to find a *compromise between site-specificity and abstraction*, as design guidelines working in the interface between site-specific and general solutions may be regarded as either ‘recipes’ for successful climate-responsive end-designs, or as too abstract and, thus, not useful.

Trust

- Visual guidelines for climate-responsive urban design should *make the invisible visible and yet credible*, i.e. making microclimatic processes tangible to designers yet without overstating or distorting them.

Interest

- Animated design guidelines should be *communicated in the shortest and quickest way possible* because, as time is often scarce in practice, readily displaying guidelines increases the chances for practitioners to apply them.
- Visual design guidelines should be prepared as *to reach practitioners in a familiar way*, as to increase their attractiveness. Aesthetic options should be made by combining personal taste, means at hand, and communicational goals and target group of the study.

We would like to place these outcomes into perspective regarding their limitations and need for further research. These recommendations pave the way for future research where it can be worth exploring other eventually relevant visual representation concepts, as well as exploring the concepts employed through other visual representation techniques, such as photorealistic imagery. Particularly relevant is the need to understand where does clearly communicating microclimate phenomena ends, and exaggeration and distortion start (“trust”).

At a time when adaptation to and mitigation of climate change in urban areas can no longer be postponed, the fundamental role of landscape architects and urban designers must be activated. This calls for providing them with tangible and credible knowledge on the topic. Visual design guidelines on climate-responsive urban design play a crucial role here. Only when designers are well informed and evidence-based applicable tools are available to them, can climate-resilient urban environments and environmentally sustainable cities be actually shaped.

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