Article

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Where Heat Becomes Public

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Abstract

The article introduces FOREST, a participatory interface prototype for communicating and negotiating urban heat risk at the scale of the shared courtyard. Instead of treating heat as a one-way disaster message or a purely technical indicator, FOREST translates residents' images, short texts, sounds, and walking traces into evidence cards that record time windows, location anchors, trigger conditions, and lived consequences. The prototype is framed as a hazard-governance method. It asks how everyday exposure, microclimate difference, and care labor can be made comparable and publicly discussable without scrubbing out uncertainty. What the article adds is a public evidence structure that links heat exposure, vulnerability, and response in a form that can support screening, review, and feedback in community-scale adaptation.

Keywords: urban heat risk; heat-wave adaptation; community governance; participatory design; microclimate; environmental hazards

1. The Courtyard of Extreme Heat, Care and Restlessness

The heat at stake in a shared courtyard is not reducible to air temperature. Residents often react to mean radiant load from paving and walls, failed night flushing, still-air corners, short-lived cooling after watering, and the way heat reorganizes care labor: moving chairs, watering earlier or later, changing children's play times, or deciding which windows can be opened without triggering conflict. Naming these specific forms of heat matters because they explain why the courtyard becomes a governance problem instead of a mere comfort complaint.

Heat waves reveal urban difference not only through rising average temperatures, but through uneven exposure, uneven recovery, and unequal access to comfort. At courtyard scale, residents face recurring questions about shade, night cooling, ventilation, and everyday care. The argument starts from that hazard condition rather than from a generic participation agenda.

Shared courtyards are important because they join microclimate, maintenance, and collective decision-making in a single local setting. They are small enough for everyday negotiation to matter, yet consequential enough for differences in labor, access, and vulnerability to become visible. That makes them useful sites for studying how heat risk becomes public (see Appendix Figure 1).

Much community knowledge about heat remains fragile: scattered across memory, oral warnings, improvised routines, and seasonal adjustments that disappear after summer. The hazard is therefore not only thermal. It is also evidentiary. Without a shared format for recording and revisiting experience, communities struggle to connect exposure, response, and fairness over time.

FOREST is proposed in response to that evidentiary gap. It treats the courtyard not as a setting to be illustrated, but as a local system in which heat perception, care work, and spatial choice can be written into comparable public records. "Playability" here does not mean adding a light game layer to a serious issue. It means organizing understanding through small actions, so that residents can review, compare, and qualify everyday experience rather than merely report that it happened (Meya and Eisenack, 2018; Rooney-Varga et al., 2018) (see Figure 1).

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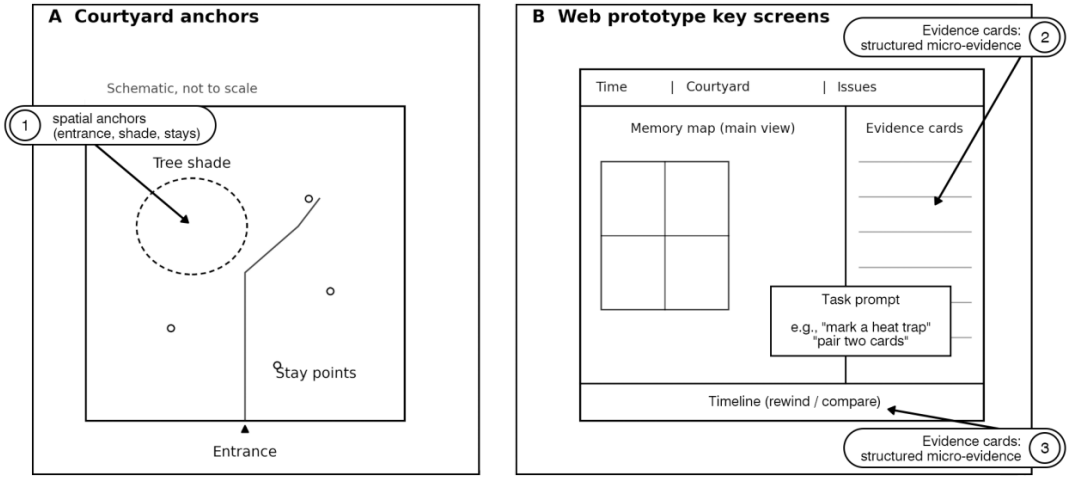

Figure 1. Prototype overview.

The interface centers on a community memory map. Residents' drawings, short texts, sounds, and path records are arranged on a scrollable timeline so that different time windows and viewpoints can be compared. In this way, heat is shifted from isolated complaint to shared evidence structure: people can see where discomfort gathers, how night cooling fails, and where care practices change what a space feels like. (see Figure 2).

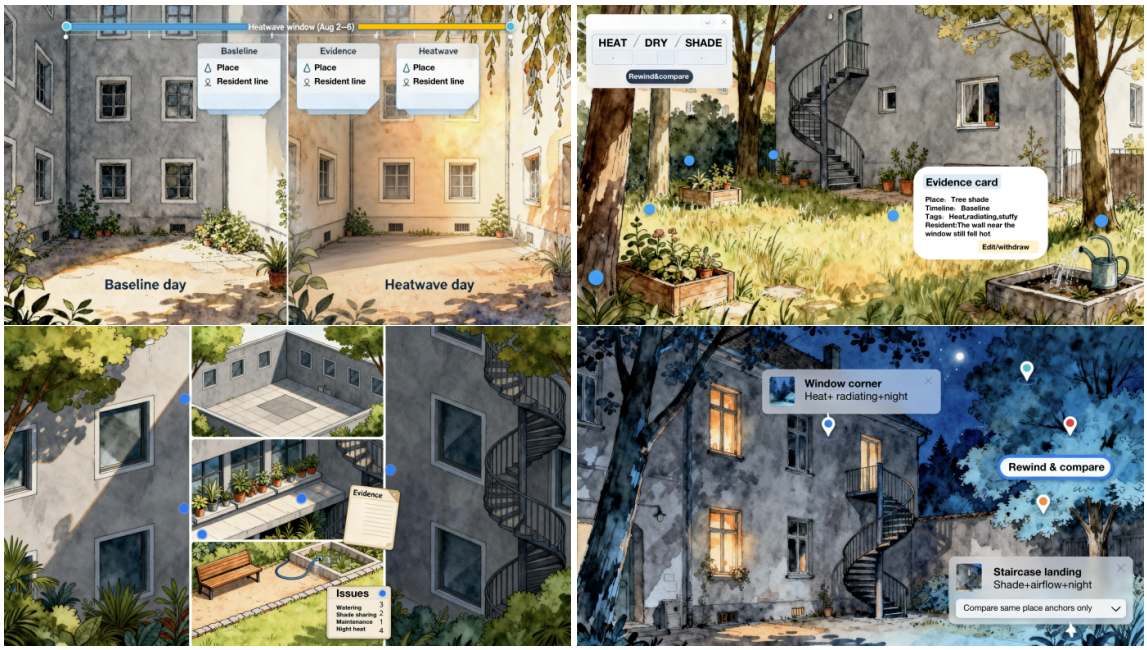

Figure 2. Main prototype screen: baseline/heatwave compare + courtyard map + evidence cards + replay view.

Narrative-visualization research reminds us that display is never a neutral container. Framing determines what readers interpret as cause, condition, or background (Hullman and Diakopoulos, 2011; Drucker, 2014). FOREST therefore avoids promising a single authoritative answer. Its aim is to let different experiences coexist on one interface and to turn difference itself into a subject of public reasoning, so that communities can ask which practices are sustainable, which burdens are unevenly distributed, and which cooling measures shift labor onto others (DiSalvo, 2009).

We will reintroduce this prototype into two interrelated analytical frameworks. One framework examines the micro-level inequality and community governance associated with the risk of the

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urban heat island effect, and the other framework explores how the participatory interface can turn "experience" into a shared public object. The key is not to prove that the courtyard can represent the city, but to explain how small-scale interfaces can still make microclimate clues, nursing practices and consultation processes visible to each other, and to leave a solid methodological entry point for subsequent in-depth residential implementation and community cooperation (Harlan et al., 2006; Zimmerman et al., 2007). (see Appendix Figure 2)

The focus here is a gap that often slips past heat-risk research. There is plenty of data on heat stress, but much less in the way of a shared format that can turn daily perception and care-related effort into evidence people can actually negotiate around. The article works through two research questions. At courtyard scale, how can scattered thermal experiences be organized into micro-evidence that can be compared, traced, cited, extracted, and reinterpreted over time? And what kind of interaction model can support a public cycle of review, comparison, argument, and revision without rushing differences into consensus or flattening them into averages?

What the article adds is not a finer heat map. It offers a set of transferrable interface mechanisms instead: a "playable community memory map" as a public-interface hypothesis for heat-wave adaptation, a minimum structure for evidence cards plus ethical controls such as visibility, withdrawal, and reinterpretation rights, and a governance path through which prototypes can be deployed and tested as consultative infrastructure.

Thermal adaptation measures in shared living environments are hard to implement less because people do not care, and more because there is no shared model residents can keep referring back to. Only when residents can write their sensory experiences and care practices as "micro-evidence" with time windows, key points, and action anchors, and allow those records to be marked, reinterpreted, and withdrawn during debate, can thermal risk move from personal statement to negotiable public object. FOREST tests this proposition through the "memory map + evidence card" structure. Its purpose is not to draw conclusions for the community, but to provide a set of reasoning rules that let differences be reviewed, coordinated, and revised.

The urban heat island effect is not a simple "temperature rise" problem; it is a complex problem determined by space, materials and institutions. Under the condition of the same daily maximum temperature, the differences in radiation, ventilation, shading, humidity and night heat dissipation capacity in different blocks will lead to an extremely uneven distribution of heat risks, especially when heat accumulation at night and heat waves last longer, and this difference is more significant (Oke, 1982; Stewart and Oke, 2012; Santamouris, 2015). So, governance faces a typical mismatch: policies and models tend to communicate through aggregate indicators, but the public perceives background clues such as "a certain intersection is more stuffy", "a certain street cannot dissipate heat at night", and "a certain building is like a hot box". The trouble is not the lack of data, but the lack of an expression and alignment mechanism that can transform the situational clues into the object of discussion.

Seen that way, heat becomes a means of governance. It does not depend on "more scientific explanation" or "higher-resolution level", but on how different entities jointly generate and recognize evidence. Science and policy never come out of thin air. They transform the world into manageable objects through classification, scale and thresholds, and these choices in turn determine which experiences are seen and which are excluded (Jasanoff, 2004). The study of common management and adaptive governance has repeatedly emphasised that the key to social learning is not to turn the public into quasi-experts, but to coordinate, debate and modify different forms of knowledge around the same object, thus forming a sustainable consultation process (Berkes, 2009; Norström et al., 2020). So, for a public-oriented hot interface, to enter the governance environment, what it needs to do is not to "show", but to transform experience into the infrastructure of boundary objects so that differences can fall into the same set of evidence structures (Star and Griesemer, 1989).

FOREST's proposal is not an alternative to the "heat risk map", but a public interface hypothesis. Through the structure of "memory map + evidence card", it organizes personal exposure into a comparable, traceable and verifiable micro-evidence unit, thus shifting the focus of the discussion from

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"I feel very hot" to "under what conditions, in what spatial relationship, and what kind of exposure occurs under these conditions". The role of this interface in governance is not to provide conclusions, but to provide a set of reasoning grammar that can be refuted and corrected, so that the public, managers and experts can negotiate around the same set of conditions (DiSalvo, 2009; Reed, 2008). (see Appendix Table A1).

If the difficulty of dealing with the heat wave is that "there is enough evidence, but not all evidence is consistent", then the problem that FOREST needs to solve is how to turn the scattered sensory experience and fragmented clues into what the governance system is willing to accept. The key is not to create a more detailed heat map, but to establish an auditable chain of evidence to transform personal experiences from "emotional statements" into "conditional records with boundary restrictions". From the perspective of boundary objects, the interface must meet two types of constraints at the same time: it must be close enough to the daily language of residents, and it must have a classified, retrievable and aggregateable structured form so that management institutions can classify, retrieve and aggregate the same object, so that different entities can collaborate around the same object without sharing the same worldview first (Bowker and Star, 1999; Star and Griesemer, 1989).

At the operational level, FOREST can be regarded as a "lightweight hot event recording and reinterpretation framework". Each evidence card does not state "who is right and who is wrong", but binds four types of minimum fields: position anchor point (such as "kitchen entrance", "shady boundary"), time period (normal day/heat window/night/afternoon peak), trigger conditions (no wind, no shade, high reflectivity material, humidity, etc.) to And experience the consequences (sleep disorders, detours, shortening the stay time, quarrels, etc.). These provisions work together with visibility, modification and withdrawal mechanisms to ensure that each statement is accompanied by applicable boundaries, so that disputes are more likely to be based on conditions and mechanisms than on opposition.

When such structured evidence is incorporated into governance practice, there should be three clear "transition points". The first transition point is screening and triage: prioritise frequent micro-exposure scenarios (such as "high temperature and low-lying places on the street at night" and "unshady waiting points") as a priority list for inspection and small-scale transformation, rather than only taking action when macro indicators are triggered. Next is the proofreading and review stage: managers or research teams will cooperate to randomly check some projects (such as on-site temperature measurement, materials and shade records, wind duct and sky visibility factors, etc.), and record the verification results back on the evidence card to form a public record that can be refuted and modified, so as to advance social learning from oral discussion to the accumulation of knowledge update (Berkes, 2009; Norström et al., 2020). Finally, this is about decision-making and feedback: when a smaller modification (shading, spraying point, water-permeable road surface, reflectance improvement, open cooling space) is implemented, the interface should be able to display "which evidence cards this measure responds to", and allow the public to continue to submit perceived differences after implementation, forming a minimum but closed feedback loop to avoid public participation staying in the "opinion collection" stage instead of "modification action" stage (Reed, 2008).

Still, this public interface must also be prevented from being abused by the system and become a performance indicator of "we have carried out public education". In order to avoid it becoming a cover for governance, the mechanism of the interface needs to reflect two forms of constraints. The first step is to clearly distinguish between "evidence contribution" and "policy commitment": the public submits verifiable clues instead of automatic commitments that trigger resource allocation to avoid misleading the public into the process of immediate fulfilment of commitments. The second point is to disclose the source of uncertainty and deviation: which areas have insufficient samples, which items have not been verified, which projects are more susceptible to the impact of tourist traffic and the distribution of mobile devices, and incorporating these limitations into the output format instead of hiding them in the method appendix (Rowe and Frewer, 2000; Reed, 2008). This does not weaken

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persuasiveness; instead, it positions the interface as a negotiating infrastructure rather than a machine that draws conclusions, so as to build credibility in the governance environment.

2. Site & Governance Snapshot (Germany): Freiburg im Breisgau (Vauban-Style Co-Housing Courtyard)

In order to make the "governance interface" scheme have a verifiable scope of application, we take Freiburg im Breisgau, Germany, as an example, and draw on its typical characteristics (such as the Wobang region) to explore the thermal risks and cooperative/cohabitation practices in the Upper Rhine Valley, so as to build a " The field of "auditable". The following example aims to support the transferability of the prototype mechanism (not the domain assertion for a specific community) (Tummers, 2016; Winklmayr et al., 2023). (see Table 1).

Table 1. Community courtyard context and mapping to prototype mechanisms.

Element	Snapshot (auditable description)	Correspondence with the prototype mechanism
Community scale / shared semi-public space	An enclosed shared inner courtyard serving approximately 20–40 households (semi-public; access can be controlled). Typical shared facilities include a courtyard notice board, shared tool room, bicycle storage, and a common activity room. Use density increases markedly in summer and during heatwave periods.	Provides clear references for “place anchors / stop points / path logs”. The notice board can serve as a QR entry point and as an offline–online connection node.
Decision-making mechanism (proposal / execution)	Governance typically proceeds via a monthly residents’ assembly (Hausversammlung) and working groups. Common ownership structures include cooperatives (Genossenschaft) or condominium owners’ associations (WEG/HOA). Minor maintenance decisions can be made quickly; items involving budgets and retrofits require voting and/or board sign-off, and may be outsourced for execution.	Embed “cards” into the meeting agenda: Card → agenda reference → resolution item → version / responsibility record, forming a traceable deliberation chain.
How maintenance labour is allocated	Routine upkeep (watering, cleaning, deploying/retracting shade cloths, temporary cooling measures) is often organised via rota schedules or volunteer hours. During heatwaves, “care debt” can accumulate (a small number of people end up carrying more work, which is hard to see).	Make “responsibility / rota / maintenance burden” explicit as card fields to prevent care work from being romanticised or erased. Supports withdrawal, re-interpretation, and redistribution of responsibilities.

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Table 1. *Cont.*

Element	Snapshot (auditable description)	Correspondence with the prototype mechanism
Courtyard key components (anchors)	Tree canopy and shade boundaries; thermal hotspots on wall/ground materials; water access points (courtyard tap / rain barrel); benches, children's areas, and other micro-infrastructure are the spatial elements most frequently referenced when thermal comfort differences and conflicts arise.	Supplies identifiable material–exposure objects for the "causal-sentence template" (e.g., missing shade / reflective wall / water-point rules → changes in thermal comfort and behaviour).
Typical heatwave conflicts	Disputes over watering priorities under water restrictions; shading devices affecting circulation, sightlines, or usage rights; night-time window ventilation triggering noise conflicts; and fairness debates about prioritising vulnerable groups (e.g., older adults, infants).	Provides real conflict contexts for "comparison / look-back / conditional sentences", and helps validate misreading controls (avoid catastrophising; avoid moralising responsibility).
Deployment entry points (go-live / management / meeting citation)	Management permissions are typically held by the board and/or a property manager. Go-live can rely on a lightweight community website or a hosted page; residents enter via the notice-board QR code and the monthly newsletter. Meeting citation uses an exported "card pack": Card ID + time window + place anchor + causal sentence + evidence/uncertainty tags; it can be pasted into meeting minutes and linked back to the version history.	Clarifies the handoff point "from cards to governance action": exportable, citable, and link-back capable—supporting auditability and cross-year reuse.

Note: The adaptive research in the above field is based on the public information of Wobang's participatory planning and cooperative practices, as well as the German heat wave/upper Rhine Valley heat risk literature (Winklmayr et al., 2023).

3. Turning Fragments into a Public Map

The evidence-card format is therefore doing more than tidying testimony. It is converting situated complaints into conditional records that can survive disagreement. A card that says "west wall, 22: 00-23: 00, masonry still releasing heat, lower-floor resident avoids opening window because courtyard noise rises" is governance-ready in a way that "it's unbearable here" is not. Still, the paper is right to preserve withdrawal and reinterpretation rights, because these records sit close to neighbor relations and can easily become overexposed if the interface treats them as fixed truth.

From the beginning, this prototype deliberately avoided treating the courtyard as a "space photo waiting to be displayed". The real value of the shared courtyard is often not the perfect scene at a specific moment, but the daily maintenance, item allocation, space utilisation and minor repair. So, the material of "The Forest We Can Live" does not come from "the story I want to tell", but from "things that have been discussed repeatedly in the community but have never been properly preserved". Differences in physical feelings during the heat wave, the predictability of shadow movement, debates about watering and water saving, "unclaimed" areas in some corners, and the imbalance in the distribution of care labour between different families - these phenomena rarely appear in statistics, but often appear as evidence in the context of governance. They determine whether subsequent

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"adaptation" measures can be accepted, maintained and long-term effective in the community (Mol, 2008; Jackson, 2014).

In order for such evidence to be constantly updated by the community itself, the process of joint creation and collection is designed as a low-threshold but repeatable workflow. It prioritises a method that does not rely on expensive sensors, so that communities can continue to integrate their experience into the system even if there is no research team. The basic unit collected is not "one interview ends", but detailed and dense micro-evidence. For example, a picture, a description, a ten-second audio clip, and a stopover on the path. The key is not the artistic quality of the material, but that each material must contain a comparable anchor point, at least including time (hot weather or normal weather), location (specific location in the courtyard), behavior (watering, shading, cooling, gathering, quarrelling, maintenance, etc.) and a describable sense. Vocabulary (sultry, itchy, burning, damp, difficult to breathe, wind can't blow in). This is not to quantify life, but to ensure that the experience is not only limited to emotional intensity, but can be understood by others as "recurred situations under certain conditions", so as to enter the negotiation stage (Sanders and Stappers, 2008; Bjögvinsson et al., 2012). (see Appendix Figure 3).

Painting and writing have become the main media because they can appear in the community in a less confrontational way. These drawings allow people to bypass the language structure of "I can't convince you" and directly depict the positional relationship between shadows, wind, heat, plants and people. These sentences are more like daily dictation records, which can retain the details that are often erased in the minutes of the meeting, such as "The room is still hot at 10 p. m. " The kitchen entrance is always the most stuffy place. The chair in the shade is always the most likely to cause quarrels, because different people occupy the chair first. The collection of sound data complements another evidence that is often overlooked: heat is not only a temperature reading; it is also a change in the acoustic environment. The sound of cicadas when the heat wave hits, the noise of fans and motors, the action of opening and closing windows, and the collective reaction during short rain, all of which bring "climate" from an abstract concept back to the rhythm of daily life, making people realise that adaptation occurs not only at the technical level, but also in the body's rearrangement of daily life (Kester, 2004; Bishop, 2012).

If these materials are not converted into structures that can be used for interfaces, they will soon accumulate into a warm archive, staying at the level of "like" and unable to enter the category of governance discussion. So, the prototype adopts the mapping logic of "evidence card": every material entering the system is compressed into a card, including location, time, medium type, sensory keywords and a feasible question. Here, we deliberately use interrogative sentences instead of concluding sentences to avoid the interface drawing conclusions for residents prematurely, while maintaining the openness of the materials. For example, "Why does the shade here always disappear in the afternoon? " Who is responsible for watering during the heat wave? " If the water consumption is reduced, how can this tree canopy survive? " In this way, the card can be used as both a narrative node and a trigger point for negotiation. Keywords are not designed as "emotional emojis". Instead, they are more like indexes, allowing different residents to use different words to refer to the same spatial conditions and form comparable clusters in the interface, thus avoiding simplifying complex experiences into simple labels (Bowker and Star, 1999; Star and Griesemer, 1989).

The interface narrative structure is naturally formed from this. It is not a linear narrative, but more like a memory map for walking, allowing users to switch between three modes: timeline mode, space mode and theme mode. The timeline shows the process of the heat wave, but does not describe it as an emergency. Instead, it allows users to observe the cumulative process of continuous high temperature and night temperature drop, as well as various prevention and control measures that occur and then disappear during heat waves. The spatial perspective divides the courtyard into several "microclimate rooms". Instead of relying on professional heat maps to create a sense of authority, it uses the daily experience of residents to superimpose a simple and powerful distribution map, so that people can intuitively see that even in the same courtyard, there are still cold spots and hot islands. The topic

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view directly presents the governance problem. Each topic is associated with a series of evidence cards. Users can view and compare these cards to understand the "root cause of the argument", not just judge who is right and who is wrong (Drucker, 2014; Hullman and Diakopoulos, 2011). (see Appendix Figure 4).

In this structure, "operable" means breaking down understanding into action, rather than turning public issues into incentive mechanisms. This task is designed as a very short public micro-labour: find a hot place and mark it at the most uncomfortable time of the day; use two cards to form a causal sentence, such as "reducing shadows - reducing stay time - reducing publicity - reducing willingness to maintain"; or choosing an action you are willing to take under the theme of "saving water" and explain the reason. If you want to use gold coins or points, the more appropriate definition of them is the indicator of "visible input and output" rather than the indicator of personal performance. It does not reward expressions such as "you are awesome", but records "our common achievements": for example, how many repeatable chains of evidence have been completed by the community in a given week, or how many different and scrutifiable positions have been formed for a specific issue. In this way, gamification no longer leads to individual competition, but leads to the accumulation of shared resources, avoiding bringing collective life into the field of anxiety (Meya and Eisenack, 2018; Whitson, 2013).

In the end, the goal of the prototype is to ensure that it can continue to be used by the community, not just to shine in academic papers. In order to facilitate maintenance, the content module adopts a replaceable structural design: location and time are fixed fields, media and text are fields that can be constantly rewritten, and subject tags can be adjusted according to the stage of the community. So, the interface does not aim to present a complete "climate story" at once, but focuses on cultivating the ability of continuous writing so that the community can gradually record their own microclimatic politics. It is here that the contribution of the original text has changed from "a good participation project" to more substantive content. It is not aimed at reaching consensus, but to provide a memory basis for long-term consultation, so that the shared courtyard is no longer just a symbol of lifestyle, but a small climate governance field that can continuously produce public knowledge (Ostrom, 1990; DiSalvo, 2009).

Reusable modules and interpretation units

In order to make the research results of this article portable, we decompose the core mechanism of Forest into a series of reusable interpretation units. Each unit defines its purpose, trigger conditions, minimum input field, output format, and common failure patterns and ethical risks. (see Appendix Table 1).

4. A Method That Can Survive Everyday Friction

This research adopts the method of combining participatory art and design research. The prototype is not aimed at "explaining the climate", but to establish a sustainable memory mechanism in the community, providing a place and providing reference materials for discussing issues such as high temperature, drought, shading, nursing and resource allocation. Instead of treating the courtyard as a place to passively bear climatic pressure, it is better to regard it as a well-functioning public entity and a micro-public space that needs continuous maintenance. Under this understanding, "method" is not a pre-set flowchart, but more like a set of agreements that can be maintained in real relationships: what content can be recorded, who has the right to explain, what needs to be retained as differences, and which content must be jointly confirmed. So, this article is more in line with the method of research through design, that is, to put forward a controversial proposition through a prototype and clearly outline the boundaries, failure points and transferable parts of the proposition (Zimmerman et al., 2007; Gaver, 2012; Koskinen et al., 2011).

However, unlike common human-computer interaction papers, Forest regards "participation" as the core object of processing: in a community environment, knowledge is not extracted, but generated in interaction, care and maintenance labour in daily life. This is closely related to participatory design

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and theoretical discussions around "care/maintenance" (Björgvinsson et al., 2012; Jackson, 2014; Puig de la Bellacasa, 2017). More specifically, the method consists of two mutually constrained clues: the first clue is to jointly create collections as a mechanism for material generation and power display; the second clue is the interface structure as a public memory institution for consultation and review. The process of "joint collection" is not regarded as the "user research stage", because this will fix the position of residents in the research, which will naturally lead to inequality. Every time you submit a picture, a sentence or a voice, you will do two things at the same time: one is to transform the sensory experience into shareable evidence, and the other is to expose the problem of "who provides care, who is defining the problem, and who is responsible for maintenance".

The study of co-living communities has repeatedly pointed out that the core of co-living lies not in the spatial form itself, but in the long-term sustainability of the governance mechanism, labour distribution and conflict resolution mechanism (Fromm, 1991; Jarvis, 2015; Tummers, 2016). If climate adaptation is only regarded as an external problem, it is likely to be regarded as an "extra task"; only when it is linked to the community's existing care, resource allocation and public consultation mechanisms can it become a topic of the community itself, not a problem of the project team (Ostrom, 1990; Berkes, 2009).

So, the role of the interface in this method needs to be redefined. It is not a display platform, but a tool that makes differences visible and easy to review. The reason many disputes related to high temperatures in the community continue to repert is less about someone lacks knowledge, and more about the evidence is scattered in personal perception and memory and cannot be compiled into common and reference materials. The interface "evidence card" structure here plays the role of a boundary object, allowing people from different positions to debate the interpretation of the same card instead of arguing about each other's personality (Star and Griesemer, 1989). This structure also echos the reminder of the framework effect in narrative visualization research: the presentation determines which experiences are regarded as the core and which are regarded as irrelevant information. So, the interface must structurally allow multiple paths to coexist, instead of replacing the only truth with a single narrative (Hullman and Diakopoulos, 2011; Drucker, 2014).

It is here that "playability" is no longer just a style preference, but has become a method choice. The playability mechanism decomposes understanding into action, enabling people to build their own causal relationship through choice, combination, comparison and reflection. It is more like an open reasoning exercise than a reward-oriented entertainment (Flood et al., 2018; Mol, 2008). If integration or unlocking is imperative, then the record should also be the collective accumulated materials and the progress of negotiations, not individual performance. Otherwise, coexisting communities will be unconsciously pushed into another performance-based governance model. In the context of urban climate governance, this aspect is particularly sensitive. That is to say, when the risk of high temperature is unevenly distributed, it is not necessary to emphasise "who is more proactive", but which conditions make it more difficult for some people to participate in coping, which labour is more likely to be ignored, and which comfortable life is taken for granted. Hiding these structural problems in the "warm community story" will make the article look more attractive, but it will weaken the essence. So, the research method must combine aesthetics with political significance. Caring for labour and space comfort is not only personal pleasure in the private sphere; instead, they are necessary conditions for the sustainable development of public life (Puig de la Bellacasa, 2017).

One of the most common ethical problems in participatory projects is to regard "participation" as a decorative procedure: on the surface, residents appear in the video, but in fact, researchers monopolise the right to interpret the content (Arnstein, 1969; Sanders and Stappers, 2008). In order to avoid this situation, the right of withdrawal and the right of reinterpretation clauses have been added to the prototype design. The right of withdrawal means that any content can be deleted or rewritten, especially when it involves family privacy, conflict details or may cause pressure within the community; the right to reinterpretation means that these cards are not "the final version of the residents' experience", but residents can supplement, refute or re-mark the content of the note over

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time. Text and interface also need to maintain a humble tone at the language level. They should avoid using grand expressions such as "voices representing the community" as much as possible, but present "reproducible differences and traces of consultation", presenting consensus as a result of work, rather than a pre-set state of harmony (Reed, 2008; DiSalvo, 2009).

The transferability of the method framework does not come from "copying the same web page", but from copying a series of relationships, establishing norms for collecting evidence, transforming evidence into a structured form of discussion, and using the playable mechanism as a norm for public reasoning, not entertainment. The courtyard is just an entrance. It is not trying to replace urban governance, but to materialise the most untouchable aspects of urban climate governance - daily maintenance, public consultation and who will bear the cost of heating. As long as these relationships are also established in other places, this prototype is not only a community work, but also a climate public interface method that can be learned from other microspaces. (see Appendix Figure 5).

5. Research Boundaries and a Deployment Path

A further limitation is social rather than technical. The residents most willing to contribute cards, revise them, and cite them in meetings may not be the residents most exposed to heat or care burden. Some people will remain quiet because of conflict fatigue, time scarcity, digital discomfort, or tenancy insecurity. The prototype should therefore be read as a device for making more heat evidence public, not as a guarantee that the public is evenly represented. Its value lies in improving the evidentiary format, not in solving participation inequality by interface alone.

FOREST is not presented as the result of a completed long-term deployment. It is presented as a hazard-governance prototype whose value lies in whether it can keep everyday heat exposure, care labor, and disagreement available for review. The article therefore treats the prototype as a method framework to be stress-tested, not as proof that adaptation has already been achieved.

The immediate achievement of the prototype is modest but important: it establishes a discussable structure for recording and revisiting everyday heat experience. That matters because community adaptation often fails not for lack of concern, but for lack of durable public objects around which exposure, responsibility, and modification can be negotiated.

Mechanism Verification: Deployment and Evaluation Plan

We redefined the definition of "evaluation" from the effect statement to the mechanism verification. The goal is not to prove that the prototype brings quantifiable cooling or behavioral changes, but to test whether FOREST really shifts the focus of discussion from attributing to personality to conditional boundaries, evidence citation and distribution maintenance, and to apply the right of withdrawal/reinterpretation in practice. Design: Subject (pairing) pre- and post-test, n = 24 participants; effect amount: Cohen's dz = mean (post-test - pre-test) / standard deviation (post-test - pre-test); 95% confidence interval: non-parameter bootstrap party based on the pairing difference Method (10, 000 resampling; percentage confidence interval); scale mean value (taken from your draft): GE 3.42-4.62, EU 3.60-4.72, FA 3.26-3.48. (see Figure 3).

In terms of writing, this part takes the "two-week pilot window period + one topic meeting" as the minimum deployment unit: participants need to submit at least two evidence cards (in limited form) within the window period, and can modify, edit or withdraw the existing evidence cards.

This pilot is a short-term exploratory deployment under the premise of informed consent; no personal identification information is collected; according to the local guidelines on the lowest risk participatory design research, no ethical approval is required.

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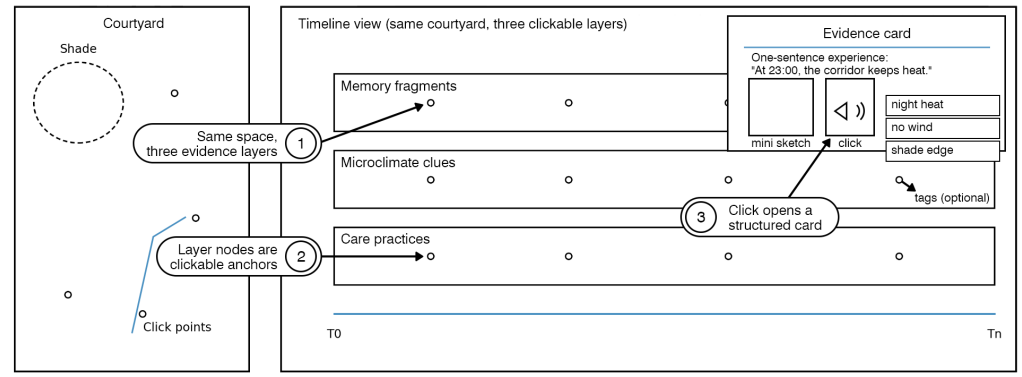

Figure 3. Conceptual diagram of deployment and evaluation path.

Mechanism verification mainly relies on three observable indicators (which can be obtained from meeting minutes/oral minutes and system logs):

M1 Conditional transformation: the proportional change of "conditional sentences/constraint sentences" (for example, "without wind/shady. ") and "personality attribution sentences" (for example, "you are too sensitive/you always. ") in the meeting discussion. It is recommended to encode by transcribed text unit and report coding consistency (for example, Cohen's κ coefficient of double labelling). (see Supplementary Figure S1).

The actual application of M2 rights expression: the incidence of re-marking/editing/withdrawal of evidence cards and its time sequence (for example, whether the withdrawal focuses on controversial issues; whether the editing is mainly used for supplementary conditional boundaries). This indicator is used to test whether the "right of withdrawal/right of reinterpretation" is just a statement.

M3 Institutionalised citation (adoption of meeting minutes): the citation ratio of evidence card ID in the meeting minutes/action list (for example, "citation frequency/total number of topics" and "the number of unique cards cited"). This indicator is used to test whether the card really becomes the boundary object of negotiation, not just stay on the interface for browsing. (see Table 2).

Table 2. Results.

Indicator	M_pre	M_post	Δ	Cohen's dz	95% CI (bootstrap)
Governance efficacy (GE)	3.42	4.62	1.20	1.41	[0.91, 2.30]
Evidence usability (EU)	3.60	4.72	1.12	1.18	[0.81, 1.81]
Fairness/agency (FA)	3.26	3.48	0.22	0.37	[-0.03, 0.90]

The point of future deployment is not to celebrate a finished design, but to test whether communities can actually use the interface to cite experience, revise claims, and negotiate comfort and fairness over time. If that happens, the contribution is not aesthetic novelty but a more durable local infrastructure for heat-risk discussion.

6. Discussion as an Ending: Memory as Commons Infrastructure

If participatory art can bring us an important revelation, it is that public practice is not necessarily aimed at reaching consensus. For problems like the heat wave, consensus is often an overly perfect arrangement, which erases conflict and inequality from the surface and replaces it with the seemingly united "let's work together". The value of dialogue and collaborative practices lies in whether they

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can tolerate differences and whether different experiences can be retained in the same public space without being immediately purified (Kester, 2004; Bishop, 2012). The interface structure of FOREST is not so much to pursue "community stories" as to realise the "rewatchability of community debate". When disputes are recorded as materials, they may become more mature when the next heat wave hits and evolve from repetitive consumption to learnable institutional evolution. This is the key to the sustainability of public resources (Berkes, 2009). (see Supplementary Figure S2 and Appendix Table C1).

This method will inevitably face an aesthetic contradiction. Courtyards are easily regarded as a symbol of an ideal lifestyle, especially in the discussion of the urban heat island effect, greening and harmonious coexistence are often romantically portrayed as "a better life". However, what this article repeatedly emphasises is exactly the opposite: comfort is not a symbol; comfort is a public state created. It is a state that needs to be maintained, assigned, negotiated and debated. If comfort is regarded as a natural gift, governance and labour will disappear; if the community is described as a healing utopia, inequality and conflict will disappear. The interface is visually restrained, and the narrative is paralleled with short sentences and evidence, all in order to control the political dimension within the visible range, so as to avoid watching replacing understanding and aesthetics replacing responsibility (Nixon, 2011; Mol, 2008).

What is transferable in FOREST is not its visual style, but its evidentiary grammar: how to write experience as conditional micro-evidence, how to keep withdrawal and reinterpretation possible, and how to connect local records to screening, review, and feedback. In that sense, the paper contributes a hazard-communication method for community-scale adaptation rather than a fixed design template. (see Supplementary Figure S3).

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org.

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