INTRODUCING ATLAS: A VISUAL STIMULI DATABASE FOR STUDYING THE AFFECTIVE EXPERIENCE OF ARCHITECTURAL ATMOSPHERES

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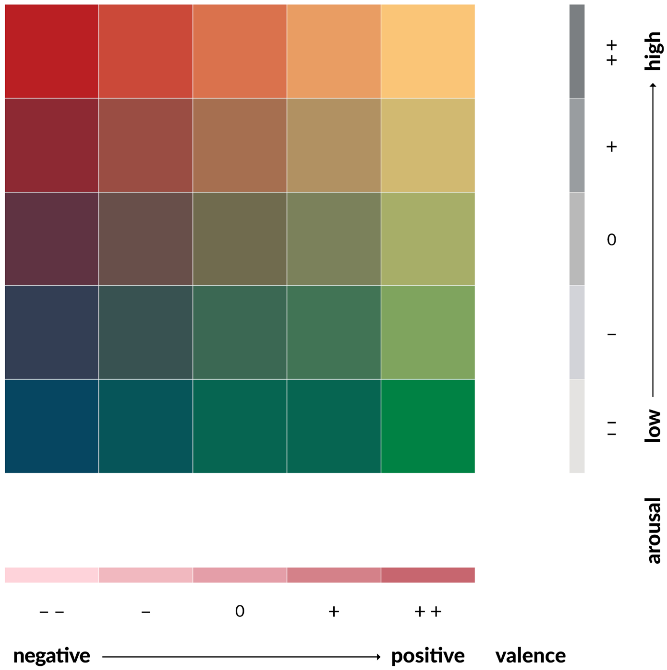
ARCHITECTURAL ATMOSPHERE
AFFECTIVE EXPERIENCE
SPATIAL REPRESENTATION
EXPERIMENTAL STIMULI
AROUSAL AND VALENCE

Atmosphere, as the affective character of a space, shapes our conscious and non-conscious emotional experiences. Growing interest in this phenomenon has led to interdisciplinary approaches that integrate phenomenological first-person evaluations with neuroscientific third-person measures. However, studying the emotional effects of architectural atmospheres in behavioral and (neuro)physiological experiments requires affect-based stimuli specifically designed for spatial contexts-resources that are currently lacking. To address this gap, we developed ATLAS (Database of Visual Atmospheric Stimuli), a collection of sixty-six spatial patterns derived from thirteen generators of atmosphere (e.g., colors, materials, textures, lights, and proportions), structured to elicit a broad spectrum of arousal and valence states from a controlled baseline corridor. ATLAS aims to become an open-access tool built to support scholars in exploring emotional responses to architectural features. This paper outlines the conceptual framework, design methodology, and future applications of ATLAS, emphasizing architecture's role in emotion research through its expertise in atmospheric design, spatial representation, and graphic processing.

INTRODUCTION

As the philosopher Karsten Harries observes, "the need for building cannot be reduced to the need to achieve physical control of the environment" (1983, p. 16). Indeed, architecture–or rather, the art and science of shaping our surroundings–"produces atmospheres in everything it creates" (1991, p. 36), as the philosopher Gernot Böhme states, emphasizing that buildings are not merely technical or functional constructs but also deeply influence our sensory and emotional experiences. Atmosphere, as a place's intuitive and overarching affective character, engages us on conscious, preconscious, and especially nonconscious levels, serving as a fundamental architectural dynamic in exploring our emotional complexity.

From a methodological perspective, the interpretation of architectural atmospheres has traditionally been dominated by a phenomenological approach (Canepa, 2022a; Griffero, 2014), which focuses on how affective experiences are consciously felt in the first person. Among the different strategies developed to capture the qualitative aspects of our lived experiences–collectively known as *phenomenographies* (De Matteis et al., 2019)–visual representations such as drawings, collages, photographs, and videos hold significant potential. Their strengths manifest in two ways: they leverage architects' graphic expertise (Canepa, 2025) and evoke atmospheric effects on their own (Morselli, 2021). Today's challenge is to bridge the expanding phenomenological insights into atmospheric processes with recent cognitive science advancements on the body, brain, and emotion-related mechanisms by integrating first-person evaluations with third-person measures (Jelić & Canepa, 2026). Whether employing self-reports and/or biofeedback sensors, laboratory studies on emotions often rely on standardized and validated stimuli depicting real-world scenes, such as pictures and videos, which must be carefully calibrated to the specific research question and context.



In other words, when designing image-based surveys (Canepa et al., 2019) and science-informed protocols (Canepa et al., 2025) to assess the emotional potential of architectural atmospheres, we need affect-driven stimuli expressly tailored to examine spatial settings.

Several theories explain how and why we experience emotions. One of the most widely tested paradigms is the circumplex model (Posner et al., 2005; Russell, 1980), which posits that people process and articulate their emotional states as points within a continuum defined by two fundamental, pan-cultural dimensions: *arousal* and *valence*. Broadly speaking, arousal reflects the intensity of an emotional state—that is, how strong and activating the experience is; valence describes its positivity or negativity, distinguishing between pleasant and unpleasant experiences. The precise relationship between arousal and valence remains an open empirical question (Colombetti & Kuppens, 2025), yet their combination provides a useful framework

Fig. 1 A graphic reinterpretation of the circumplex model of affect. Source: Canepa, 2023, p. 292. For the original formulation, see Russell, 1980.

for identifying emotions (Figure 1). For example, a state of low arousal and positive valence may correspond to 'calm', whereas high arousal and negative valence may be associated with 'tension'.

A pivotal resource in emotion research is the International Affective Picture System (IAPS, pronounced 'eye-apps'), which is extensively employed to investigate arousal and valence (Bradley & Lang, 2017). Developed by the Center for the Study of Emotion and Attention at the University of Florida in the 1990s (Lang et al., 1997, 2008), the IAPS offers a series of over 1,000 evocative color photographs, validated for their reliable ability to elicit specific emotional responses. Each image has been rated for arousal and valence, making the IAPS a robust and standardized tool for experiments, integrated into various disciplines and reproducible across diverse populations, contexts, and methodologies (Branco et al., 2023). However, the IAPS database has several limitations: (1) it is structured around still images that fail to capture the complexity of multisensory, real-life experiences (Schreuder et al., 2016); (2) its pre-Internet origins impose copyright restrictions that prevent its use in online surveys, which are essential for collecting data from large and heterogeneous samples (Kurdi et al., 2017); (3) the library is not regularly updated and some images may feel outdated due to changes in society and technology; (4) and, crucially for architectural applications, its limited content range lacks spatially specialized stimuli. When present, context serves merely as a backdrop and scenarios are inconsistent in composition, brightness, and detail. In short, the IAPS dataset is not suitable for analyzing visual representations of architectural atmospheres.

When exploring emotional interactions with built environments, urban spaces, or natural landscapes, standardized and validated databases with corresponding normative affective ratings are scarce and methodologies vary. As a result, researchers must prepare stimuli ad hoc for each study, which is time-consuming, raises costs, and compromises the comparability of findings.

Here are three examples of architecture-specific stimulus databases, each defined by its real-world likeness, sensory immersiveness, and freedom of movement. Gregorians et al. (2022) compiled 63 first-person-view videos from YouTube, each lasting from 31 to 40 seconds, capturing affect-laden spaces to examine the relationship between core affect (arousal and valence) and architectural experience. In an experiment by Presti et al. (2022), participants were virtually immersed in 54 abstract interiors, each differing in sidewall distance, ceiling height, window position, and ambient color, to rate their emotional responses along the arousal-valence spectrum during a 12.5-second pre-recorded walkthrough. Lastly, Canepa et al. (2019) designed 20 atmospheric variations of a corridor by modifying its plan layout, section, flooring, wall treatment, and lighting, modelling virtual reality environments that could be freely navigated for up to 60 seconds and evaluated for arousal and valence.

Building on Canepa et al. (2019), we crafted ATLAS, a dATabase of visuaL Atmospheric Stimuli, conceived as a spatial translation of the IAPS. ATLAS comprises spatial patterns derived from a systematic selection of generators of atmosphere (Canepa, 2022b)—architectural features such as lights, colors, materials, and proportions that contribute to orchestrating the overall atmosphere and shaping the emotions, behaviors, and appraisals of those who experience it. We established multiple key objectives: (1) to provide a set of pre-tested visual stimuli for analyzing emotional dynamics in lab settings, designed to resemble real-world environments; (2) to develop space-focused representations that span the circumplex continuum, including neutrally characterized configurations; (3) to regulate visual variables by maintaining a consistent level of detail, minimizing semantic cues, and reducing any differences that could influence emotional responses in ways unrelated to their affective content; (4) to ensure high-resolution quality and format flexibility by producing images and videos; (5) and to make the ATLAS project open access, supporting its use in online research and enabling the replication and extension of results across experimental paradigms.

Designing and validating a database of visuospatial stimuli for emotion research calls for an interdisciplinary approach, integrating expertise from diverse fields to guarantee scientific rigor, ecological validity, and efficient applicability. For example, (neuro)cognitive scientists bring knowledge on spatial cognition theories, emotion models, and psychometric tools; statisticians handle reliability and validity testing; and architectural scholars provide insights into architectural morphology, spatial affordances, and the atmospheric experience of spaces, while also producing visual representations—such as drawings, photographs, and videos—and overseeing image processing (e.g., adjusting brightness, contrast, and spatial frequency) to ensure controlled stimulus presentation. This paper underscores the distinctive role of architectural expertise, outlining the primary stages of the stimulus design process and illustrating how architectural practice and teaching can inform empirical research on affective atmospheres.

MATERIALS AND METHODS

PROCEDURE

A two-week workshop with fifth-year students trained in Atmospheric Design and Phenomenography at the Architecture Department of Kansas State University (fall term 2022) explored how a space's affective character—its lived and felt atmosphere—can be manipulated by applying thirteen generators of atmosphere to a shared baseline. Our surroundings are rich in information, with each feature intricately interwoven, making it difficult to isolate individual atmospheric qualities (Seamon, 2025). However, a scientifically controlled protocol requires a reductionist strategy (Canepa et al., 2019, 2025), testing one design factor at a time to identify possible correlations between implemented changes and their resulting effects.

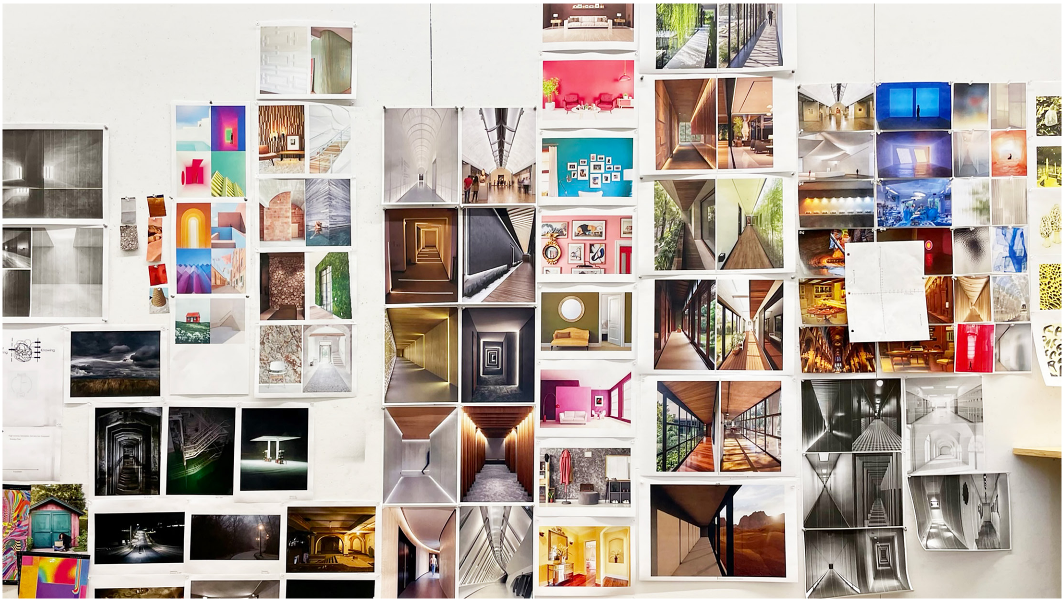


Fig. 2 ATLAS database, brainstorming, 2022. © Resonances project.

The design process for developing our ATLAS database followed six key steps: (1) literature research guided the definition of the baseline—a five-meter corridor connecting two rooms, concealed by a closed door; (2) students built a two-by-five-meter panel, arranging sketches, photographs, magazine clippings, and art-historical references to facilitate brainstorming by mapping spatial transitions and clustering compositional patterns (Figure 2); (3) each student selected a generator of atmosphere and modeled a three-dimensional environment, manipulating lighting conditions, material textures, and geometric parameters; (4) they formulated an emotion-based hypothesis about their chosen generator of atmosphere, explored it through five variations, and evaluated the emerging perceptual effects by having their classmates rate each space—exported as a central-perspective image—in terms of arousal and valence; (5) they collectively discussed the results, refined the images accordingly, and retested the stimuli; (6) after completing sixty-six interior scenarios with different degrees of atmospheric potential, one student edited all images to ensure graphic consistency

Fig. 3 ATLAS database, baseline corridor, 2022, edited by Reid Posinski. © Resonances project.

(same format, framing, perspective, brightness, color space, and resolution) and converted them into 12-second videos, where a first-person camera movement simulated walking through the corridor.

At this stage of refinement, ATLAS stimuli were ready for use in surveys and experiments (Canepa et al., 2024), aimed at generating descriptive statistics with rating information to validate the dataset. However, this step falls beyond the scope of the present paper, which focuses on illustrating the design premises and the architectural discipline's specific contributions to crafting spatially specialized visual representations of affect-evocative stimuli and advancing atmosphere research.

STIMULI: BASELINE

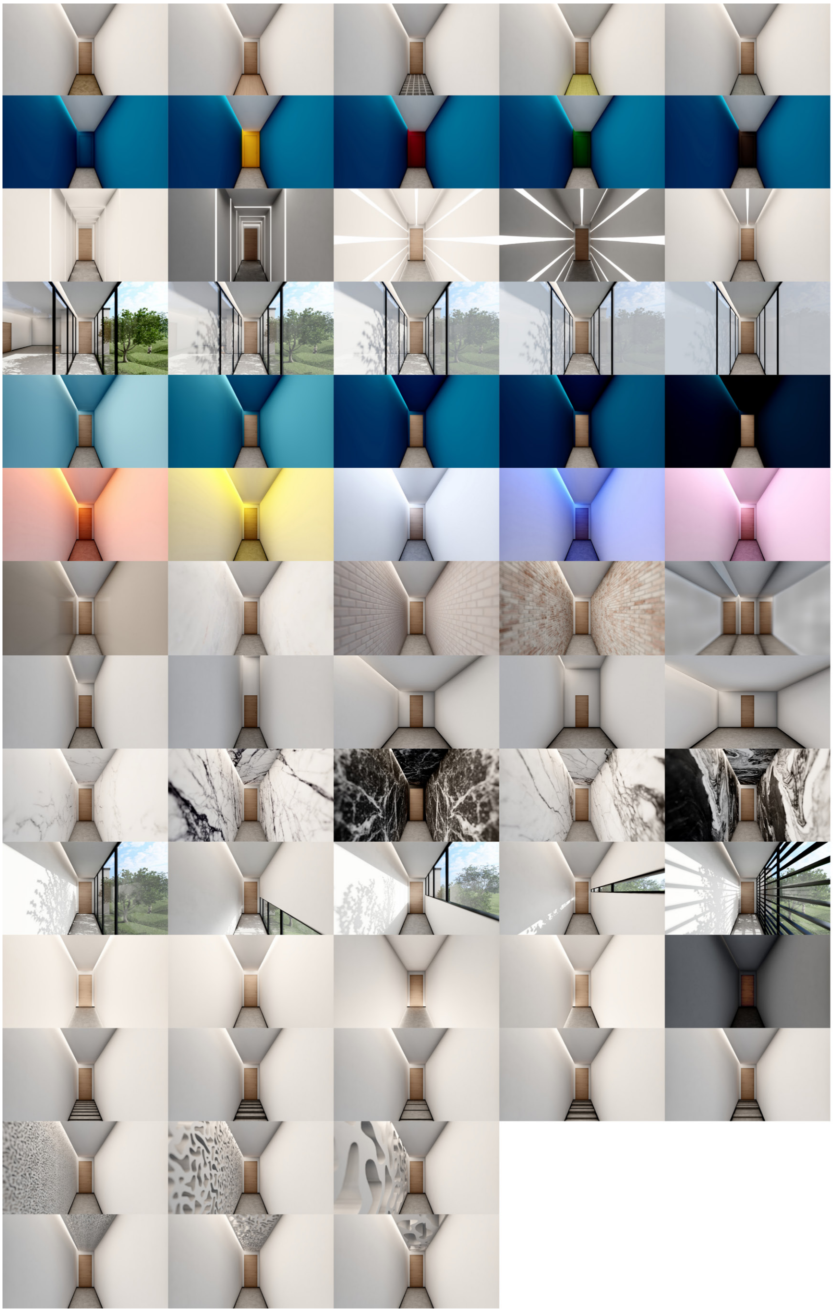
We opted for a corridor as our case study because it is a fundamental architectural element, ubiquitous as a distributive structure and closely tied to the human body proportions (Canevari, 2020; Guida, 2015; Trüby et al., 2014). Corridors inherently afford movements and evoke emotions, being often associated in the collective imagination with loneliness, darkness, risk, or endless passageways. For these reasons, research on sensorimotor and affective responses to architecture frequently examines corridors (Canepa et al., 2019; Djebbara et al., 2019; Presti et al., 2022). Our baseline corridor (Figure 3) had fixed dimensions (2.45 × 1.20 × 5.00 m), guided by the International Building Code (ICC, 2012) and proportional criteria (Proietti, 2015). To provide an emotionally neutral setting with uniform architectural quality adaptable to design practice–without being tailored to a specific sample–the floor was smooth-finished concrete, the walls and ceiling were white-plastered, and lighting emanated from a cove along the left edge of the ceiling. At both ends, we placed two closed wooden doors to spark curiosity and invite movement.

STIMULI: GENERATORS OF ATMOSPHERE

After defining our baseline, we determined thirteen atmospheric generators and developed sixty-six variations (Figure 4), interpreting each generator through five affective dimensions that span the spectrum of arousal-valence combinations (Figure 1): medium arousal and neutral valence; low arousal and negative valence; low arousal and positive valence; high arousal and negative valence; high arousal and positive valence.

A thorough breakdown of the thirteen categories of atmospheric generators is provided below.

Generator 1 modified the textural characteristics of the floor materials (sand; wood; carpet; tactile bumps; metal). *Generator 2* adjusted the walls by applying principles of color harmony theory (blue/blue; blue/yellow; blue/red; blue/green; blue/brown). *Generator 3* altered the rhythm of the lighting system (vertical sequence with low contrast; vertical sequence with high contrast; horizontal sequence with low



G01
floor
materials: textural qualities

G02
walls
colors: harmony theory

G03
walls and ceiling
light: rhythm

G04
walls
materials: transparency

G05
walls and ceiling
colors: shade

G06
walls and ceiling
light: temperature and color

G07
walls
materials: glossiness

G08
floor, walls, and ceiling
proportions

G09
walls and ceiling
textures: density and noise

G10
walls
openings

G11
walls and ceiling
light: intensity and position

G12
floor
patterns: rhythm

G13
walls
textures: organic pattern

G13
ceiling
textures: organic pattern

Fig. 4 ATLAS database, generators of atmosphere and their variations, 2022, edited by Reid Posinski. © Resonances project.

contrast; horizontal sequence with high contrast; linear symmetry with low contrast). *Generator 4* changed the transparency level of the glass on the walls (0% opaqueness; 25% opaqueness; 50% opaqueness; 75% opaqueness; 100% opaqueness). *Generator 5* introduced variations in color shades on the ceiling and walls, starting from a baseline blue tone (blue with 10% black; blue with 40% black; baseline blue; blue with 60% black; blue with 90% black). *Generator 6* modified light quality in terms of temperature and color (1,000 K; 2,000 K; 6,000 K; 10,000 K; pink shade). *Generator 7* adjusted the glossiness properties of the walls (polished metal; marble; white tiles; bricks; mirror). *Generator 8* altered the overall proportions of the space (arithmetic mean by Andrea Palladio: H = (A+B)/2, H = 3.00 m; long area postulated by Leon Battista Alberti: A/H = 1/4, H = 4.80 m; square proportion: A:H = 1:1, H = 2.45 m; golden rectangle, vertical: H = A(1+√5)/2, H = 4.00 m; golden rectangle, horizontal: H = 2.45 m). *Generator 9* focused on walls and ceilings, exploring the effects of varying texture density and noise (low density and low noise; low density and mid-high noise; high density and high noise; mid-density and mid noise; high density and mid-high noise). *Generator 10* introduced openings on the right wall, offering views to the outside (curtain wall; ribbon window at floor height; ribbon window close to the ceiling; slit window; brise soleil). *Generator 11* modified light intensity, ranging from an extremely bright configuration to a dark setting (highly bright, illuminated by four light sources; bright, with two ceiling-mounted light sources; bright, with two floor-level light sources; bright, with two light sources positioned on the left wall; dark, with minimal lighting). *Generator 12* applied different step patterns to the floor, influencing their rhythm (horizontal variation with a regular rhythm; vertical variation with a regular rhythm; horizontal double-speed variation with a regular rhythm; vertical variation with an irregular rhythm; mixed horizontal and vertical variations with an irregular rhythm). Lastly, *Generator 13* tested organic textures on the walls and ceiling (this generator uniquely featured six iterations: small-scale pattern on the left wall; medium-scale pattern on the left wall; large-scale pattern on the left wall; small-scale pattern on the ceiling; medium-scale pattern on the ceiling; large-scale pattern on the ceiling).

MEASURES: SELF-RATED RATINGS

To preliminarily evaluate the proposed solutions and refine their atmospheric qualities, the thirteen students engaged in three rounds of discussion, facilitated by the professor (first author). Each student presented five variations in a randomized sequence to their classmates, prompting quick responses to two questions, rated on a 9-point Likert-type scale from 1 ('not at all') to 9 ('extremely'). It was emphasized that there were no right or wrong answers, only subjective opinions and ratings.

1. In this corridor, I feel excited…
   This question assesses the arousal dimension, measuring the intensity of the felt emotional experience—that is, how strongly it is.
2. In this corridor, I feel happy…
   This question assesses the valence dimension, analyzing the pleasantness of the felt emotional experience—that is, how positive it is.

The peer-to-peer evaluation exercise was crucial in questioning initial assumptions, enhancing design decisions, and calibrating the salience of specific atmospheric features. This collaborative process therefore served as an informal yet meaningful assessment step, linking exploratory design work with systematic testing and informing the construction of the first version of the ATLAS.

RESULTS AND DISCUSSION

We designed sixty-six atmospheric variations of a five-meter corridor connecting two rooms, using a shared baseline, by altering its floor, walls, ceiling, and doors through modifications in proportions, materials, textures, colors, lights, and views to the outside. All preset objectives were achieved, as the ATLAS stimuli focus on spatial configurations and their atmospheric properties; represent real-world environments; maintain architectural quality adaptable to design practice; align with contemporary contexts; facilitate direct comparison with each other; cover much of the circumplex continuum, including neutral settings in arousal and valence dimensions (such as the baseline element); limit visual complexity, avoid semantic information, and ensure a uniform sense of familiarity; provide images and videos, making the stimuli suitable for diverse research applications; and are open-access, encouraging their adoption as a common standard.

Although our reductionist approach helped manage the complexity of architectural atmospheres, we acknowledge its limitations and aim to refine them in future iterations of the ALAS database. Atmospheric experience is inherently multisensory and multimodal (Pallasmaa, 1994), but we prioritized vision to craft affect-laden stimuli, recognizing the crucial role of visual perception in shaping spatial interactions (Spence, 2020). Compared to still images, engagement was more effectively increased by first-person-trajectory videos, where we integrated sounds (e.g., whooshing doors opening and closing, as well as footsteps varying with different floor materials and textures) to improve multisensory immersion. This progression from static representations to dynamic experiences reflects our methodological contribution: rather than employing visualization merely as a representational tool, we explored it as an experimental approach to test how diverse modes of exposure shape emotional responses to space. A planned objective is to develop virtual reality settings to strengthen ecological validity (Canepa, 2024), as virtual simulations enable an embodied interaction between the perceiver, their surroundings, and peripheral devices. A possible next step would be the systematic comparison of static, dynamic, and immersive media to evaluate their relative effectiveness in triggering and measuring atmospheric experience.

Corridors, while rich in sensorimotor and perceptual affordances, are characterized by reduced dimensionality and complexity (Presti et al., 2022). As transitional spaces, they may not elicit a strong enough emotional response to support conscious analysis and verbalization of feelings. This challenge parallels the broader difficulty of answering the seemingly simple question, 'How are you feeling?'; though common in daily life, responses are often inconsistent and elusive to articulate, especially in relation to spatial experiences. This suggests that, despite being informed by psychological literature, the self-reported indicators students used in their preliminary ratings may not be entirely effective, particularly in capturing arousal (the intensity of the emotional experience)–a dimension inherently more ambiguous to perceive than valence (the degree of pleasantness experienced). As a result, the 66-variation taxonomy is not evenly distributed across arousal-valence combinations, with certain configurations being too repetitive, making it difficult to discern meaningful differences in ratings. Based on normative measures obtained from validation testing, we will refine the selection of stimuli to confirm the ATLAS set. The design methodology remains flexible, allowing for the integration of more architecturally sophisticated stimuli over time.

CONCLUSION

As research on the effects of built environments on emotions continues to grow in behavioral and cognitive sciences (Bower et al., 2019), the need for validated and comparable stimuli remains a persistent challenge. Currently, no standardized databases of affect-laden stimuli exist for those who study architecture or, more specifically, architectural atmospheres. Similar to how empirical aesthetics navigates the formal, sociocultural, and historical complexity of aesthetic experience when selecting stimuli from an almost limitless pool of artworks (Fekete et al., 2023), architectural studies must address the complexity of atmospheric experience. Atmosphere is co-generated through continuous interactions with our surroundings (Canepa, 2022a, 2022b), where multiple factors—both designable and random—interplay across different levels and timescales.

To advance emotion research in architectural atmospheres, we conducted a pilot study developing a database of space-focused stimuli that vary in emotional potential, assessed along two affective dimensions (arousal and valence): ATLAS—dATabase of visuaL Atmospheric Stimuli. Our methodological priorities were atmospheric variability, architectural quality, systematic comparability, high resolution, and open accessibility. We designed our ATLAS environments for use in video-based surveys (Canepa et al., 2024) and neuroscience-informed protocols (Canepa et al., 2025). However, this paper focuses on the design process behind stimulus composition rather than the evaluation of self-reported and (neuro)physiological ratings, highlighting the distinct and essential contribution of architectural scholars—experts in spatial analysis and visualization techniques.

ATLAS aims to become an open-access tool designed to support researchers in exploring emotional responses to architectural features by providing reliable, standardized, and reproducible stimuli. This database will serve as a vital resource for experiment-based investigations, driving advancements in research questions and methodologies. We encourage future studies to expand its stimulus spectrum and refine rating data, paving the way for new discoveries in architectural and affective research.

USAGE

The ATLAS database comprises sixty-eight stimuli, including a baseline corridor and a training element designed for technical calibration or to help participants understand the experiment instructions before they engage with the actual stimuli, thereby reducing confusion and response variability. Two open-access versions are freely available for download and use: high-resolution images (Full HD, 1920 × 1080 pixels, 240 dpi, .jpg, sRGB) and 12-second first-person-view videos (Full HD, 1920 × 1080 pixels, .mp4, H.264, 60 fps). Each file is named according to a unique identifier, specifying the generator category and corridor number: for instance, ATLAS_ResonancesProject_Generator01_Corridor01. Please refer to the 'Data Availability' section for DOI entries and links. A document containing descriptions of all stimuli, summarized in Figure 4, is provided as supplementary material.

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AUTHORSHIP

All authors revised and approved the paper. EC, BC, and AJ conceptualized the research; EC supervised the students' work and was responsible for the design and image/video editing processes; EC wrote the original draft; BC and AJ edited the manuscript and supervised the research.

DATA AVAILABILITY

The RESONANCES project has agreed to participate in the European Commission's Pilot on Open Research Data within the Horizon 2020 Program, aiming to enhance and maximize the reuse of research data generated by EU-funded projects. The ATLAS dataset is openly accessible through the project's Zenodo repository (resonances-project):

DOI: 10.5281/zenodo.8157841 (images), https://doi.org/10.5281/zenodo.8157841.

DOI: 10.5281/zenodo.8170370 (videos), https://doi.org/10.5281/zenodo.8170370.

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