

The Science behind our Emotional Connection to Architecture

Most people can think of buildings that have caused them to feel a strong emotion. The comfortingly familiar smell of home after a long absence, the fascinating view from a seat that we habitually sit in, a sense of wonder and heightened awareness on entering a sacred space or the sheer delight in a designer's ingenuity at devising a novel and beautiful building.

Where does this emotional response come from? Is it entirely *subjective* and *different* for each person or might there be some *innate* property of the building itself that can elicit or prompt a *similar emotion* in all of us?

The exhibition of major projects from Heatherwick Studio at the Mori Art Museum in Tokyo is entitled '*Building Soulfulness*'. But what precisely is soulfulness? A simple dictionary definition would tell us that it means "*full of emotion*" or alternatively "*expressing a feeling of emotion*."¹ What is crucial to this definition is that it consists of two components: one about emotion itself (and implicitly 'soulfulness' seems to indicate a positive rather than negative emotion) and the other concerns the amount ("*full of*") or depth of that emotion.

In psychology, these two aspects of emotion are known as *valence*, or the degree to which an emotion is either positive or negative, and *arousal*, or the intensity of that emotion (considered more in the sense of 'activation' or 'alertness': on a scale of sleepy to attentive). If soulfulness is, therefore, redefined using standard, psychological terminology, it would signify a '*high valence + high arousal*' state, where it would sit comfortably alongside other emotions such as excitement, enthusiasm, and elation. And so, by extension, a *soulful building* would have to be any building that arouses such positive emotions.

How do buildings provoke an emotional response? It probably comes as no surprise that this question has attracted the interest of scientists over the years. It can be shown through scientific studies in psychology, cognitive science and neuroscience that buildings are able to elicit strong emotional responses in people and therefore could potentially be considered *soulful*. This paper examines in more detail the current state of scientific knowledge regarding how we respond emotionally to buildings.

Over the past three decades we have come to learn far more about how the brain works than at any other time in human history. This is primarily due to new methods which permit scientists to detect events so small and so fleeting as the firing of a single neuron in the brain. (Although techniques such as functional magnetic resonance imaging (fMRI) and EEG describe aggregate levels of brain activity rather than the level of the single neuron).

¹ Paraphrased from the Merriam-Webster dictionary. Soulfulness. (n.d.) In *Merriam-Webster's collegiate dictionary*. <https://www.merriam-webster.com/dictionary/soulfulness>.

Through this process, neuroscientists have been able to construct complex maps of the brain that show which regions support different behaviours or cognitive processes.

But despite this meticulous work and the astonishingly beautiful and intricately interconnected brain maps that result from it, there is one problem that neuroscience has yet to resolve. This problem has been described as the ‘hard problem of consciousness²’ or the ‘explanatory gap³’. Essentially this means that although scientists can identify neural activity associated with specific mental processes, they are no closer to explaining precisely how such activity aggregates into, or culminates in, our ‘experience’ of the world, and, in the context of this essay, precisely *how* this produces our emotional responses to buildings.

Nevertheless, some preliminary, exploratory work has begun to be conducted into *what design features* of architecture seem to elicit emotional responses from people as well as which parts of our brains are involved in this process. For example, it has been known for many years in psychology that *views of nature* and green spaces can have a positive effect associated with feelings of calmness and wellbeing^{4 5 6 7}. More recently, these earlier findings have been reproduced and substantiated in neuroscience experiments⁸. In another experiment, positive physiological effects of Shinrin-yoku (taking in the atmosphere of the forest) were associated with lower cerebral activity in the prefrontal area suggesting that Shinrin-yoku is able to help people feel more relaxed⁹.

Moving on from the well-known effect of green spaces, a recent paper found that people were far more likely to judge spaces to be beautiful if they contained *curvaceous* rather than rectilinear forms¹⁰ which supports previous studies performed by psychologists on people’s preferences for curved objects in general, although not hitherto specifically applied to architecture^{11 12}.

In 2020, Alexander Coburn and colleagues carried out an experiment that involved showing people two hundred photographs of architectural interiors and asking them to rate the scenes according to sixteen different aesthetic measures including, among others, complexity, naturalness, beauty, interest, and degree of comfort¹³. They found that three clusters or groups of the sixteen measures accounted for 90% of all aesthetic judgements of

² Chalmers, ‘The Conscious Mind: In Search of a Fundamental Theory’.

³ Levine, ‘Materialism and Qualia: The Explanatory Gap’.

⁴ Kaplan, ‘The Restorative Benefits of Nature: Toward an Integrative Framework’.

⁵ van den Berg et al., ‘Health Benefits of Green Spaces in the Living Environment: A Systematic Review of Epidemiological Studies’.

⁶ Ulrich, ‘View through a Window May Influence Recovery from Surgery’.

⁷ van den Berg et al., ‘Health Benefits of Green Spaces in the Living Environment: A Systematic Review of Epidemiological Studies’.

⁸ Tost et al., ‘Neural Correlates of Individual Differences in Affective Benefit of Real-Life Urban Green Space Exposure.’

⁹ Park et al., ‘Physiological Effects of Shinrin-Yoku (Taking in the Atmosphere of the Forest)—Using Salivary Cortisol and Cerebral Activity as Indicators—’.

¹⁰ Vartanian et al., ‘Impact of Contour on Aesthetic Judgments and Approach-Avoidance Decisions in Architecture’.

¹¹ Bar and Neta, ‘Humans Prefer Curved Visual Objects’.

¹² Silvia and Barona, ‘Do People Prefer Curved Objects? Angularity, Expertise, and Aesthetic Preference’.

¹³ Coburn et al., ‘Psychological and Neural Responses to Architectural Interiors.’

the interior spaces. They termed these groups: *coherence* (how clearly structured or understandable a scene is); *hominess* (how home-like or 'personal' a space seems to be); and *fascination* (the rich detail of a scene or how interesting it is). Furthermore, these three aspects could be mapped onto identifiable regions of the brain that became activated when such judgements were being made.

Building upon and further developing this work, Lara Gregorians and her colleagues from University College London have recently looked in further detail at these three aesthetic judgements (*coherence, hominess and fascination*) but rather than using static photographs in their experiments, used walkthrough movies of architectural spaces¹⁴. They also included tests for emotional valence (how positive or negative the emotion induced) and added a new test for arousal (how 'vigorous' or strong was the emotional effect). Finally, they added two measures that they specifically wished to investigate further: *spatial complexity* and *unusualness*.

They discovered *valence, fascination, coherence, and hominess* all related strongly to one another, which supported the findings of the previous study by Alexander Coburn and colleagues. They also found that *arousal* (the depth of emotions), *fascination, unusualness* and *spatial complexity* were also strongly connected, as were *beauty* and *valence*. In other words, we are more likely to find pleasant spaces *coherent, homey and fascinating*, but *fascinating* spaces may also be more *arousing, complex and unusual*.

Finally, one other design feature of buildings that is likely to elicit a positive emotional response is if a building or neighbourhood includes spaces intended for social interaction. There is an entire sub-area of neuroscience¹⁵ devoted to the social brain and how we process social interactions¹⁶ and for most people such experiences are strongly positive ones (*high valence + high arousal*).

Experiments in which people are shown scenes of social interactions (compared to scenes without social content) show that the social scenes produce greater activation in widespread brain networks associated with all aspects of social cognition¹⁷. Therefore, if we understand buildings and spaces as providing a potential for *social encounter*, then we may also be more likely to respond positively to them.

The effects of some of these design features can be combined in interesting ways. Panos Mavros, Christoph Hölscher and colleagues tested the interaction between urban versus natural environments and crowded versus uncrowded conditions on people's emotions whilst also determining if people's responses differ depending on whether they are walking through, or statically occupying, the space¹⁸. Their experiment involved people watching

¹⁴ Lara Gregorians et al., 'Architectural Experience: Clarifying Its Central Components and Their Relation to Core Affect with a Set of First-Person-View Videos'.

¹⁵ Hari et al., 'Centrality of Social Interaction in Human Brain Function'.

¹⁶ Quadflieg and Koldewyn, 'The Neuroscience of People-Watching: How the Human Brain Makes Sense of Other People's Encounters'.

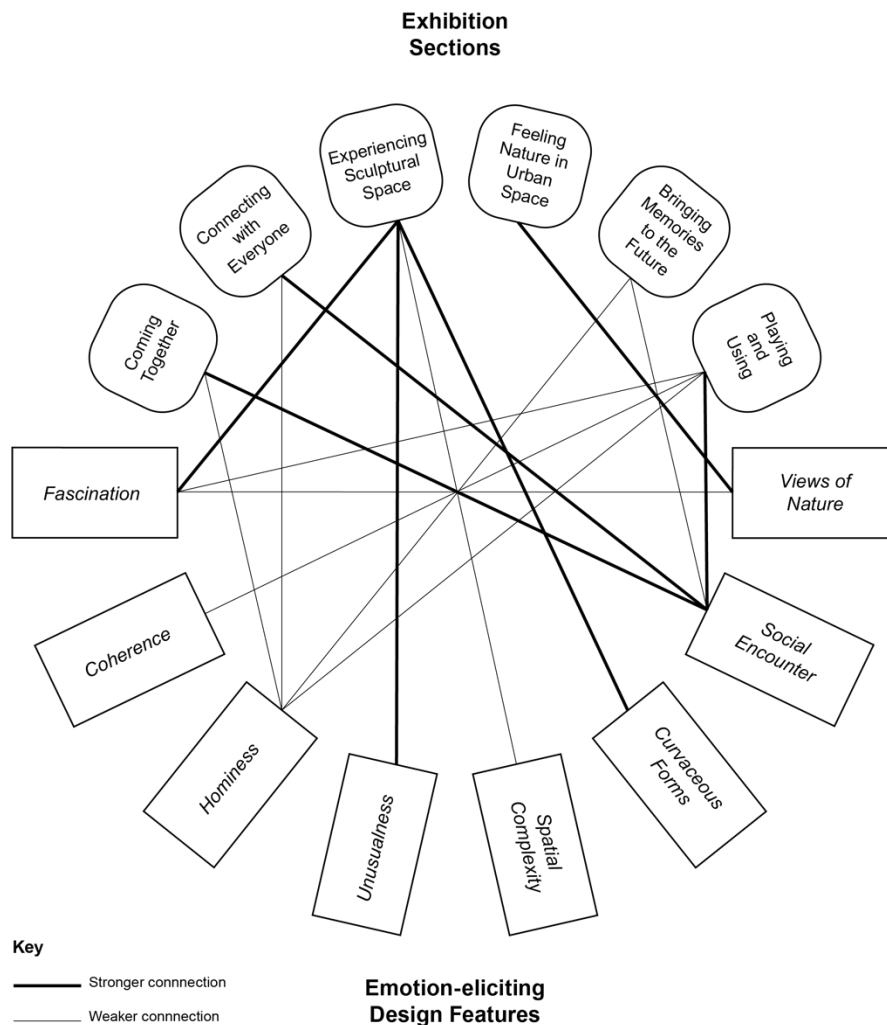
¹⁷ Vrticka, Sander, and Vuilleumier, 'Effects of Emotion Regulation Strategy on Brain Responses to the Valence and Social Content of Visual Scenes'.

¹⁸ Mavros, Austwick, and Smith, 'Geo-EEG: Towards the Use of EEG in the Study of Urban Behaviour'.

walk through movies, whilst walking (or standing still) on a treadmill and wearing an EEG headset.

Their results showed that when viewing scenes containing high densities of crowds, people generally reported more negative emotions. However, an interesting result occurred when this was combined with the effect of walking versus static viewing. External, crowded scenes were viewed far more positively when walking. It is therefore possible that we do enjoy, or 'get a buzz' out of, vibrant, well-populated, urban outdoor environments, and that this effect is further enhanced if we are walking through them, rather than sitting in them.

We have now established a list of building design features¹⁹, supported through neuroscience research, that appear to produce strong, positive emotions in people: fascination; coherence; hominess; unusualness; spatial complexity; curvaceous forms; views of nature and spaces for social encounter. It is interesting to note how many of the different sections of the 'Building Soulfulness' exhibition relate directly to these emotion-inducing building design features, as shown in the diagram below.



¹⁹ There are other individual features that have been studied and could be listed (for example, boundary height and ceiling height which seems to have an effect on behaviour) so this list is not intended to be definitive.

Figure 1 Diagram showing how the exhibition sections map onto those design features shown to elicit an emotional response

In this next section, three projects have been selected that illustrate how Heatherwick Studio's projects incorporate many of these emotion-inducing design-features. This is not to say, of course, that other projects might not have been chosen, or indeed that each of these three projects fulfil all the design-features (it is highly unusual for all features to be present in any single building). However, between them, these three projects cover all the features and permit a deeper exploration of what is meant by them.

Maggie's Yorkshire: Hominess, Views of Nature & Spaces for Social Interaction

Maggie's Yorkshire, previously Maggie's Leeds, (located in the 'Connecting with Everyone' section) is a centre for the Maggie's charity which supports anyone, and their families, with cancer. Their centres are co-located on hospital sites and Maggie's Yorkshire is situated on the site of St. James' hospital in Leeds. The charity's motto is "Everyone's home of cancer care" and therefore it is no surprise that one prominent emotional aspect of Heatherwick Studio's design is its sense of *hominess*.

This characteristic of the design potentially manages to evoke people's personal memories of 'home' and heightens feelings of placefulness and belonging. It cannot be underestimated how important this is for individuals undergoing cancer treatment. What is surprising about this building, however, is how such a strong sense of *hominess* comes hand-in-hand with strong forms, *curvaceous* surfaces and an *unusual* design, since it could be expected that such *unusual* interior spaces might cancel out any sense of *hominess*, as ordinary people tend not to live in houses with soaring, ribbed, arched ceilings and yet, Heatherwick Studio managed to combine these two, very different, aspects in the design.

The other striking feature of Maggie's Yorkshire is how much greenery and *views of nature* the designers have managed to incorporate, something that was very important from the beginning of the project, since the building was constructed on one of the last remaining green spaces on the hospital site. The building seems to almost 'explode', exuberantly, with an abundance of plants that have been incorporated or inserted into every part of the building, ensuring that wherever you are in the building you are surrounded by nature.

Finally, given the location of this building in the exhibition, another aspect of the building that helps people respond emotionally to it, is the importance it places on bringing people together at the heart of the building. Even looking at unpopulated photographs of the building, it is possible to 'read' the clear social intent of the spaces and respond, emotionally, to this potential for social interaction.

Nanyang Technological University Learning Hub: Fascination, Spatial Complexity & Curvaceousness

Nanyang Hub (located in the 'Connecting with Everyone' section) is a learning centre of Nanyang Technological University in Singapore. It is a university building providing a place

for interdisciplinary meetings and collaborations. It is clear that the materiality of the building has the potential to elicit an emotional response through its ability to invoke a sense of *fascination*.

According to environmental psychologists the *fascination* of a scene or view can be attributed to how richly detailed or how interesting it is. In the case of Nanyang Hub, the elaborately textured walls (horizontal or undulating textures in some places or three-dimensional drawings cast into the concrete in others) provide exactly this source of *fascination* that should attract interest and stimulate imaginative reflection.

Fascination is also triggered by *green elements* — plants — and the Nanyang Hub also incorporates them into the interior and exterior surfaces of the building. There is an interplay with Singapore's contemporary urban tradition of building 'a city in a garden' and, like Maggie's Yorkshire, it articulates new architectural ways to bring people in closer contact with nature through novel architectural vocabularies.

The spatial layout of the Nanyang Hub is both simple — it is an atrium building encircled by individual learning spaces — and at the same time complex, with its angled columns and *curvaceous*, pod-like forms. What is particularly interesting is how long lines of sight connect dispersed parts of the building while at the same time it maintains a sense of the smaller scale (*hominess*) with nooks for study and social interaction. Some of the views from inside seem almost fractal in their visual and *spatial complexity*. We know from the neuroscience research described above that *spatial complexity* is one of the factors likely to produce a strong emotional response, and this building is a wonderful example of this.

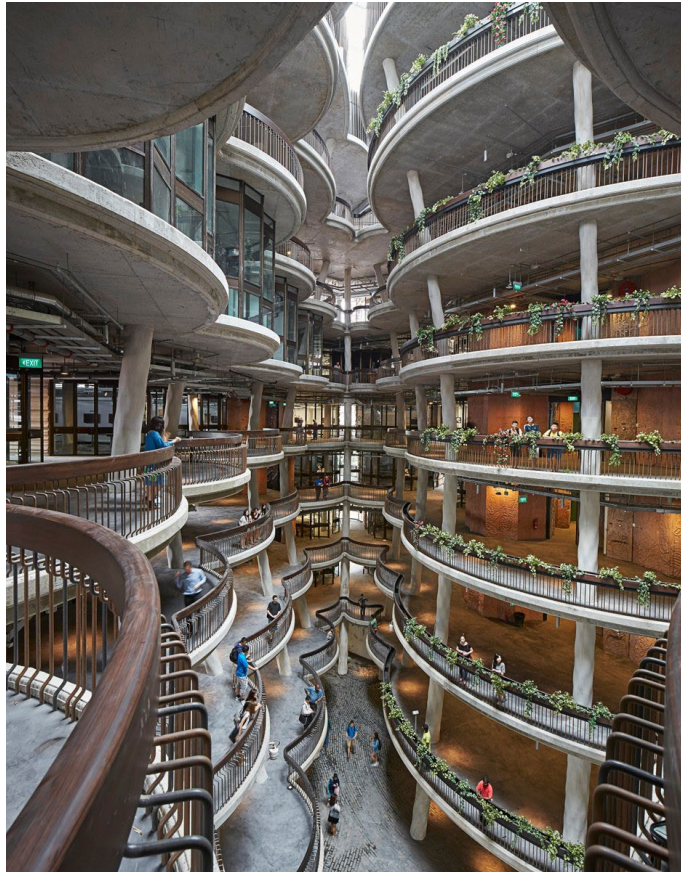


Figure 2 Nanyang Hub. Note the fractal-like visual/spatial complexity

Little Island views of Nature, Unusualness & Coherence

Little Island is, literally, a little island located off the west side of Lower Manhattan in New York. As is consistent with its inclusion in the *'Feeling Nature in Urban Space'* section, it demonstrates how nature can be imaginatively woven into even the most densely urban spaces. However, it clearly also fulfils many of the other emotional criteria for architectural design.

In particular, it is *unusual*. Even in a location where piers thrust out into the water were historically common, this is by no means a typical 'pier' but an unashamedly man-made island, the likes of which exist nowhere else in the world. And as well as its form being *unusual*, the undulating landscape and the shape of the supporting structures attract interest through their *curvaceous* design.

Finally, *coherence*, or how clearly structured and understandable a scene is, appears particularly evident in Little Island: on approaching the park, any visitor will clearly understand how it consists of a structure of *curvaceous*, funnel-like supports of varying heights. And once on the island, the views around, as well as from, the spaces make it easy to know where you are on the island at any moment in time.



Figure 3 Little Island, an exemplar of how to incorporate views of nature, unusualness & coherence

Together, these three examples have demonstrated how the eight design features might produce an emotional effect in people experiencing these spaces.

Heatherwick has spoken at length about the idea that emotion should be treated as function of architecture^{20 21}. The idea of functionalism in architecture has a long history²² which, according to Adrian Forty, was initially associated purely with a building's structural performance and only later, in the twentieth century, began to be associated with a building's effect on, and use by, people.

Function, in essence, can be thought of as the degree to which a building fulfils its intended purpose and is strongly associated with a sense of utility. Louis Sullivan famously coined the phrase '*Form follows function*', this being the idea that for every specified function, use or activity, there is an ideal architectural form that best supports it.

The issue with this is that it leads to a form of determinism, namely that a specific use will lead inexorably to a single ideal form. This, in turn, can lead to a diminution of the creative act. Not surprisingly, in recent years, functionalism (or the adherence to such ideas) has fallen out of fashion, especially as it came, retrospectively, to be strongly associated with the most extreme and minimalist forms of modernism as well as the failures of post-war architecture and urban design.

Might functionalism be considered the opposite of soulfulness? If the idea of a functional building is one in which strict rationality is adhered to and anything superfluous, extraneous or *joyful*, is removed in pursuit of rationale utilitarianism, might those very aspects of a building also be lost — those characteristics that have recently been found by scientists to

²⁰ Heatherwick, 'Building to Feel Good and Do Good : More Emotion in Architecture Will Benefit Both People and Planet'.

²¹ *The Rise of Boring Architecture and the Case for Radically Human Buildings*.

²² Forty, *Words and Buildings: A Vocabulary of Modern Architecture*.

elicit positive emotional responses (fascination, coherence, hominess, unusualness, spatial complexity, curvaceous forms, views of nature and spaces for social encounter). This is surely the architectural equivalent of 'throwing the baby out with the bath water'. Alternatively, what happens if the idea of soulfulness, joy and love are elevated to the level of *becoming a function* in their own right?

It could be argued that this was first proposed by Vitruvius who suggested that architecture should fulfil three criteria (or meet three functional requirements): *firmitas* (structural stability), *utilitas* (appropriate social/spatial purpose) and *venustas* (aesthetically pleasing). If we could imagine a hypothetical conversation between Vitruvius and Thomas Heatherwick, I am sure that they would find themselves in perfect accord: agreeing that Heatherwick's idea of emotion as a necessary function of buildings and Vitruvius' concept of *venustas* as a requirement for architecture are entirely compatible.

If emotion were to be considered a function of architecture, would we then need to be able to *test* for whether a building is fulfilling its emotional functional requirements? In this next section another Heatherwick Studio project will be used to suggest how this might routinely be achieved. How, for example, might we test the '*emotional efficacy*' of the Azabudai Hills development in Tokyo?

This an 8.1-hectare site that is, essentially, an entire urban district containing residences, offices, retail facilities, hotels, cultural facilities and an international school.

Like many of the experiments described above, a controlled laboratory experiment would be preferable to conducting experiments in the real world. This is because it is easier to control conditions in a laboratory, ensuring the exact same experience for each participant. Equally, laboratory experiments mean it would be possible to test the '*emotional efficacy*' of a project before it is finished.

Rather than using photographic images or movie clips of scenes, participants could view 3d movies of the project through a VR headset making them feel as if they were 'really there', virtually inhabiting the neighbourhood. This would come as close as possible to simulating the true experience of being in the real-life district.

Six locations from within the Azabudai Hills development would be selected for filming. VR movies from six corresponding locations in a different, contemporary Tokyo neighbourhood would be used as an experimental control²³. Participants would *virtually stand in* each location whilst wearing a wireless mobile EEG headset. This EEG data would be supplemented by asking people to describe their emotional feelings about the project.

What results might we expect to see? First, the high levels of greenery and landscape planting in the Azabudai Hills should clearly elicit strong positive feelings and we would expect that these would be both subjectively reported as well as measured via the EEG data.

²³ An experimental control is part of a test which is used as a benchmark or a point of comparison against which other experimental results are measured. In this case we would be looking to see if the Azabudai Hills neighbourhood produced a stronger emotional response than a more conventional, but still contemporary, district.

Significant and measurable differences in valence (positive emotions) between the Azabudai Hills and the 'control' neighbourhood should also be found. This would be due to the increased arousal and sense of *fascination* stimulated by the scheme's *spatial complexity* and *unusualness* of its design as well as the use of *curvaceous* forms in the scheme.

Furthermore, for those outdoor spaces occupied by people in the VR movies, we would expect these to produce a stronger (arousal) positive emotional affect in response to the potential for *social interaction* and encounter. Having concluded such 'emotional tests' both client and architect could be reassured that their intentions had been met.

Although the scenario above is a fictional one, it is entirely plausible that in the future, standardized testing of the emotional effect of designs could become routine and incorporated into the design process, particularly for large schemes like the Azabudai Hills.

In conclusion, therefore, could the idea of a *soulful building* have a scientific basis? The evidence appears to say yes. Buildings can arouse strong, positive emotions and neuroscience has demonstrated how specific aspects of building design such as fascination, coherence, hominess, unusualness, spatial complexity, curvaceous forms, views of nature and spaces for social encounter can clearly result in a soulful building.

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