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Zen and the Art of Surfboard Design

by **Daniel Webber**

Abstract

The aim of this paper is to show (a) how motion has ontological priority over space and (b) how the relationship between motion and form underpins mindness. The analysis of spatial perception reveals an interplay between spatial and temporal relations that is evident in language and surfing.

There is something about surfing a wave that touches the very essence of what it is to be alive. It is hard to explain to non-surfers how it feels to carve across a wave, to push the limits of your surfing ability and to surf even better than you thought you could. There's a magic in surfing that only the experience itself can communicate. One surfs *with* the wave, drawing on experience to manoeuvre the surfboard in synchrony with the wave, all the while anticipating how it will change shape. If one thinks of the surfboard as the medium for surfing expression, then surfboard design is its language. It is the structure through which surfing's magic can flow. The aim of surfboard design is to refine this structure so that surfing expression can become more fluent.

This essay presents a phenomenology of design based on spatial perception. The hypothesis is that spatial perception underpins the perceptual skills needed to design an object as an extension of the self. Spatial

perception emerges from an interplay between spatial and temporal relations. The spatial paradigm separates an object into its component parts, so that the temporal paradigm can join them together. This can be seen in language and surfing, where creativity stems from the ability to engage temporal relations, such that spatial relations emerge spontaneously.

Surfboard Design

The surfboard design process can be described as building a bridge between shape and context, based on function. According to this approach, the designer is concerned with two sides of a relationship (Alexander, 1964). On the one side, there is the shape of the surfboard itself. On the other side is the surfboard's context, which is every external condition that influences its function.

The most obvious factors that play a role in a surfboard's context are physical in nature; from the surfer's weight to the size and shape of the wave. These are taken into consideration when deciding on a surfboard's length, width and thickness/volume. However, the ultimate aim of surfboard design is to relate shape to purpose, since the ideal is a surfboard that becomes absorbed into the surfer's intentions. The surfer's intentions are therefore also part of the surfboard's context, making it part of the design process too.

In considering the surfer's intentions, the designer analyses how the surfer's movements affect the response of the surfboard. Basically, the surfer turns the surfboard by leaning his body and extending his legs and feet to varying degrees. However, what concerns the designer it is not the mechanics of the human body, but the nett effect. The designer thus reduces the surfer's influence to a set of rotational axes. At this level of abstraction, the surfer's intentions can be represented diagrammatically, enabling the designer to more easily visualize the different phases of a manoeuvre, as well as the transitions between them.

Whatever the axis of rotation, manoeuvres can be divided into two phases, a penetration phase and a release phase. The penetration phase is characterized by the inward rotation of the surfboard, while the release phase involves its outward rotation. By visualizing each phase in terms of its rotational axis, or sequence of axes, the designer can identify which portions of the surfboard come into play for a given manoeuvre.

Having established a link between the surfer's actions and the under surface of the surfboard, the designer is ready to include the notion of resistance. The focus here is on the degree of drop-off allowing the water to escape. Imagine a straight line drawn across the bottom surface, depicting the flow of water. Now picture this line as a cross-section of the bottom contours, as if drawn on a piece of graph paper. The curve of this cross-section determines the force generated during the penetration phase of the manoeuvre. For example, a concave curve is more responsive than one which is convex.

For the sake of simplicity, the greatest amount of resistance is achieved by rotating the surfboard sideways, since the bottom curve aligned with this plane of rotation provides the least drop-off. Subsequently, the penetration phase of a manoeuvre tends to be characterized by rotation of the board in or near to this plane. By contrast, the release phase is characterized by a transition from this rotational plane either toward the centre plane, by directing the water out through the tail, or into the horizontal plane, by sliding the tail out. The horizontal plane obviously provides the least resistance, since it is limited to the surface area of the fins. However, the loss of resistance felt in the central plane results from the surfboard's rocker, since the greatest amount of surface drop-off is directed through the tail.

The blending of these curves, which fan out from the centre of the board, influences the transition from rail-penetration to release through the tail. Although curvature from nose to tail and from side to side, by themselves, determine the extent to which penetration and release contribute to a surfboard's performance, it is the blending of curves between these two extremes that ensures that the board enters and exits turns smoothly and with minimal loss of speed.

Although surfboards can be represented in 3D, with movements reduced to rotational axes, surfing manoeuvres are as much the transition between rotational axes as the axes themselves. It is therefore exceptionally difficult to visualize at this level of abstraction, without drawing on actual surfing experience.

To design an object as an extension of the self, one must transcend the spatial limitations of the body. This is not to say that there exists a metaphysical plane of consciousness. On the contrary, an extension of the self depends on the structural coherence of consciousness and physiology.

Immediacy

The most basic assumption we have about objective reality is our own spatially derived presence, whereby

our surroundings provide the context for our own presence. Neurologists point to the posterior superior parietal lobe – the portion of the brain Newberg and D'Aquili (2001) have dubbed the *orientation association area*, or OAA:

> The primary job of the OAA is to orient the individual in physical space – it keeps track of which end is up, helps us judge angles and distances, and allows us to negotiate safely the dangerous physical landscape around us. To perform this crucial function, it must first generate a clear, consistent cognition of the physical limits of the self. In simpler terms, it must draw a sharp distinction between the individual and everything else, to sort out the you from the infinite not-you that makes up the rest of the universe.

They suggest that reduced neural activity in the OAA during transcendence indicates a deficit condition resulting from a lack of information processing:

> Would the orientation area interpret its failure to find the borderline between the self and the outside world to mean that such a distinction doesn't exist? In that case, the brain would have no choice but to perceive that the self is endless and intimately interwoven with everyone and everything the mind senses. And this perception would feel utterly and unquestionably real.

However, by assuming that the spatial limits of the self are the *absolute* limits of the self, they overlook the key attribute of transcendence, which is the heightened sense of immediacy. They fail to acknowledge that the brain has to first generate a perspective from which to interpret the spatial boundary of the self.

One's perspective emerges from *Optic Flow*; those movements in the scenery that are attributed to one's own movement. In essence, the mind uses these movements for the sake of determining one's moving perspective. Since the correlation between these movements and one's own motion is immediate, the relationship between them contributes to one's sense of immediacy. However, while our perspective resides in the present moment, the interpretation of space suppresses our experience of the present moment by harnessing our perspective to navigate space. The mechanism that renders the world as spatial does so at the expense of our own immediacy.

We use a variety of cues to perceive depth; motion is only one of many. One of the most powerful cues to depth, especially at short distances, is binocular disparity, the difference in the images received by each eye. We also make use of accommodation, the thickening and thinning of the lens of the eye in order to better focus on near and far objects respectively. Additionally, we use a number of "pictorial" cues to depth, such as the fact that nearer objects occlude further objects (occlusion), nearer objects are larger than further objects (relative size), and nearer objects are further from the horizon (relative position).

Although motion is not the only means by which depth is interpreted, it distinguishes itself from all other depth cues by virtue of its temporality. Depth variations revealed by motion are determined across time. The mind determines the shape of an object, or an empty space, based on how its appearance changes over time. These changes in appearance only make sense to the extent that they are relative to the observer's perspective. So, the process of determining depth through motion effectively harnesses the observer's perspective, with the result that our sense of immediacy is dulled.

While space seems like a solid foundation for presence, however, it is not as fundamental as it seems. As far as perception is concerned, it is a façade that masks the fluidity of one's perspective. Paradoxically, this fluidity is more resilient than space, because it is the foundation for spatial perception.

Through meditation it is possible to retract one's awareness from the world, and in so doing to dissolve the division between one's perspective and the object of one's attention, such that one's very perspective becomes the object. Then one does not see the surroundings so much as the movements in the surroundings that indicate one's own motion. Subject and object merge and the here-and-now becomes palpable.

The "sharp distinction between the individual and everything else" only applies to our spatial presence. Our immediacy extends beyond this boundary. The so-called inner and outer worlds are intertwined within our consciousness. One's perspective emerges from the changing appearance of one's *surroundings*, and the so-called "outer" reality only gains its spatial character from the projection of one's *own presence*. What emerges from this discussion, however, is a distinction between spatial and temporal relations, where space is in fact 'imagined' and the nature of transcendence extends beyond our physical boundary.

While it is perfectly sensible to treat the world as objectively present, the spatial paradigm is by definition divisive. By contrast, the temporal paradigm is inclusive. However, the nature of this connection is not to be understood in spatial terms. It sounds absurd to say that "the self is endless and intimately interwoven with everyone and everything the mind senses" without first dissolving the spatial paradigm. It infers that the mind is misinterpreting its relationship to the world. On the contrary, during transcendence, the mind perceives the foundation of its own presence. The extraordinary connection felt during meditation doesn't just feel real, it *is* real. But it is a connection to the present moment, rather than the physical world as such.

Spatial and Temporal Relations

Optic Flow determines the point-of-view from which we perceive space. Or, conversely, the perception of space depends on a point-of-view, which in turn depends on *Optic Flow*. Although a moving point-of-view can be described as a line, this is only how it looks within the spatial paradigm, which cannot depict movement other than in spatial terms. Besides, *Optic Flow* presents a veritable sea of moving points, which collectively determine the moving point-of-view. Not that they are seen as points or lines, however. Instead, the mind attends to the different rates at which the different parts of the scenery slide past each other.

Spatial perception *takes shape* within the fluid movement of one's own visual perspective. Just as a wave changes shape as it enters shallow water, vision converges with the visible to render spatial relations. The confluence of movements coalesces to give us the impression of form in our surroundings. Like a wave, spatial perception propagates through reciprocal causality. Motion determines the observer's perspective, which detects the spatial relations that situate the observer. There are thus two directions of causation: a feed-forward from motion to space, and a feed-back from space to motion. The observer's perspective rides the interface between space and motion.

The Spatial Paradigm

To perceive how shape affects performance, the surfer-shaper has to visualize shape in the context of motion. This is a radically different approach from that of spatial perception, which normally sets motion in the context of space.

Space provides a sense of motionlessness – which serves, in effect, as a frame of reference to show how motion differs from it. For example, we typically regard motion as a change of position, a reference to something fixed. But, as a consequence, motion is seen as a movement *in* space when it is actually a movement *of* space – a space in motion.

The spatially derived model of reality is based on how the dimensions differ from each other. Space is characterized by the difference between a plane and space. The planes set the context for the *idea* of space. The edges of a plane provide a context by showing the line where the plane ceases to be a plane. The difference between a line and a plane is what the concept of a plane is based on. To visualize a line, we give it ends. Each end of the line is a point and together they serve as the context for the line. They show the difference between a line and a point, and in this way they define the point at which a line ceases to be a line.

Successive dimensions build on lesser dimensions; for example, a line evolves as a series of points. Each dimension can thus be 'placed' within dimensions higher than itself, but not lower than itself. However, while this is clear for each of the dimensions leading up to the three dimensions of space, it is not so clear how time 'contains' its lesser dimensions. The problem is the spatially derived model of reality. We understand the passing of time to be in relation to the present moment, as if the 'now' has no duration. We supposedly experience a string of nows. However, it is only for the sake of the concept that the passage of time differs from the present. The contrast does not reflect reality, but the setting of a context.

The Temporal Paradigm

What the concept of time fails to take into account is that successive dimensions merge. They are not discrete. Each dimension carries within it the dimensions lesser than it. So, instead of focusing on how the dimensions differ from each other, we will consider how they differ in themselves. This reveals that the essence of a point is its location, the essence of a line is its alignment, the essence of a plane is its form, and the essence of a space is its density.

In considering how a motion differs in itself, one is tempted to describe it in linear terms: for instance, by delineating the path it follows. But this is not its essential quality, since a line has just one dimension, not four. Neither can we narrow it down to its location, form or density, though that which moves certainly has these characteristics too. But all these things being equal (imagine two identical movements side by side), there remains one characteristic which belongs solely to motion: its speed. This is how

motion differs in itself – making speed the essence of motion.

The variable of speed is beyond the ordinary conception of motion, so we tend to regard it as inconsequential. But motion in the sense of speed is precisely how it ties in to reality. This can be observed in the shape of a wave. It is not simply that the form would not exist without motion, but that the variable of speed determines the variety of curves in a wave. A standing wave behind a rock in a stream is a good example of this principle: the water flows through the wave while the form expresses the various speeds at which the water is moving.

The whirlpool is a particularly good example, because the dimensions are seen to be variables linked in a unified system. There is the alignment of its axis, the form of its surface, the matter it draws inward, and, since a vortex rotates progressively faster toward its centre, the variable of speed. Placing a tiny pointer in a whirlpool can show the part played by motion. The pointer remains parallel to its original alignment, despite being carried around and around. This indicates that motion, rather than content, determines the form (Schwenk, 1976).

The concept of time fails to account for the diversity of change, since the division of time and space implies that change is restricted to the fourth dimension. However, assuming that change is the very essence of reality, rather than a mere aspect of it, it follows that the essence of each dimension is how that dimension changes. By setting each dimension in the context of change, the concept of time subsequently loses its significance as one of the dimensions, and, as such, is separated from space. To subordinate the dimensions to the concept of time ignores the crucial point that each dimension finds its expression in change and that change is, moreover, what holds them together.

The Interplay between Spatial and Temporal Relations

Spatial perception is an emergent process resulting from the coupled dynamics of brain, body and environment. While its basic function is to situate the agent in space, the observer's perspective vacillates between the spatial and temporal paradigms. Too much of the spatial paradigm causes the individual to see himself as an object. Too much of the temporal paradigm makes him oblivious to his circumstances. The individual needs to balance the two paradigms, to be able to act decisively in circumstances that continually change, because the ability to anticipate change underpins the ability to read a situation.

The interplay between spatial and temporal relations is evident in language, where the sequence connects components that are selected from alternatives. For example, the symbols that combine sequentially to make words are each taken from an alphabet, being the set of alternatives. Each word in a sentence is selected from the set of grammatical components that combine sequentially to form different grammatical structures. Phrases combine to form sentences and so on and so forth, with the emergence of ever larger categories that overshadow their constituent parts to create larger units. The interplay between spatial and temporal relations permits numerous categories of signification to be expressed at the same time, from letters and words to denotation and connotation.

The movements of the tongue during speech can be likened to riding a surfboard. The basic components of speech sounds, *obstruents* and *sonorants*, can be likened to the penetration and release phases of surfing manoeuvres. *Obstruents* are produced by obstructing the air flow against a range of articulation points within the vocal tract. By contrast, *sonorants* are produced without obstructing airflow through the vocal tract. Since *obstruents* and *sonorants* alternate like the penetration and release phases of surfing, the different combinations of *obstruents* and *sonorants* are analogous to the surfer's repertoire of manoeuvres.

Numerous sounds remind us of shapes. This is classically demonstrated by the *Kiki and Booba* experiment (originally performed by Wolfgang Köhler**,** 1929). In this experiment, a drawing of two aliens is presented (see *Figure1*).

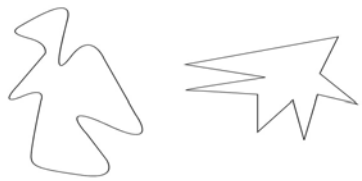

*Figure 1***.** Kiki and Booba (Ramachandran & Hubbard, 2001, p. 19)

The subject is asked to identify which alien is *Kiki* and which is *Booba*. The vast majority of respondents identify *Kiki* as the pointy shaped alien and *Booba* as the rounded one, indicating that our perception of sound and shape overlaps. This form of cross modal perception is analogous to the surfer-shaper's ability to associate the shape of a surfboard with its response during surfing manoeuvres. The sound of the word "kiki" is more closely associated with sudden changes in direction, as depicted by the drawing of a spiky

figure. By contrast, the sound of the word "booba" is more closely associated with long, drawn out turns, as depicted by the drawing of a curvaceous figure.

The stimulation in one modality that triggers sensations in another is called *synaesthesia*. For example, a synaesthete may consistently experience a specific colour when hearing a particular tone or looking at a certain numeral. Mild forms of *synaesthesia* permeate consciousness, as revealed by the sounds *Kiki* and *Booba*, which invoke an association with shape. For example, a painting by Kandinsky has been found to trigger activity in portions of the brain that are associated with hearing (Ward, Thompson-Lake, Ely, & Kaminski, 2008). *Synaesthesia* might also play a role in other forms of self expression. Dance could even be regarded as a form of *synaesthesia*, in this case sensory-to-motor, where the rhythm of movements synaesthetically mimics the auditory rhythm (Ramachandran & Hubbard, 2001). Similarly, the design skills of a surfer-shaper could be regarded as creating a synaesthetic link between surfing manoeuvres and the shape of the surfboard.

Such motor-to-sensory synaesthesia would probably be underpinned by mirror-neurons, so-named because they fire in response to movements that share a common trajectory, whether performed by you or someone else. Mirror neurons are believed to be implicated in learning to speak (Ramachandran & Hubbard, 2001). They facilitate the transfer of skills, for example from parent to child, by coding movements in terms of their purpose (Gallese & Metzinger, 2003). As a result, the mind learns how to deal with objects through their use, which is fundamentally different to their spatial presence, since the use of an object extends the self beyond its physical limits.

To design a surfboard as an extension of the self, the surfer-shaper has to decipher manoeuvres in terms of the spatial and temporal paradigms. The axes of penetration and release represent the set of alternatives from which manoeuvres are composed, just as the letters of an alphabet are combined to form words. The similarity between the movements of surfing and the movements of speech is evident in passages that employ *onomatopoeia*, where the sound of a word, or group of words, seems to characterise its denotation. For example:

> True ease in writing comes from art, not chance,
> As those move easiest who have learned to dance,
> 'Tis not enough no harshness gives offence,
> The sound must seem an echo to the sense.
> Soft is the strain when zephyr gently blows,
> And the smooth stream in smoother numbers flows;
> But when loud surges lash the sounding shore,
> The hoarse, rough verse should like the torrent roar:
> When Ajax strives some rock's vast weight to throw,
> The line too labours, and the words move slow;
> Not so, when swift Camilla scours the plain,
> Flies o'er th' unbending corn, and skims along the main.
>
> Alexander Pope (1711/2004), *An Essay on Criticism*, ll. 362-374

The above extract demonstrates the perceptual overlapping of sound, movement and meaning, which is analogous to the perceptual overlapping required to design a surfboard. The set of speech sounds is analogous to the set of curves present in a surfboard. The sense of movement induced by the speech sounds is analogous to manoeuvring the surfboard. The meaning of the poem is analogous to the order of execution, as this displays the surfer's understanding of the wave, which is analogous to our understanding of context. In each case, the (temporal) sequence connects the components that are (spatially) separated from alternatives.

As with poetry, the essence of a design is the experience of its use. The interplay between spatial and temporal relations allows past experience to inform present experience. In language, the sound of an utterance feeds forward to form words, which feed back to invoke the experience of meaning. In surfing, the shape of the surfboard feeds forward to form manoeuvres, which feed back to invoke the experience of surfing. Just as the components of language are assembled to generate speech sounds in the vocal tract, the components of surfboard design are assembled to generate manoeuvres on the wave.

About the Author

Daniel Webber is one of the six Webber Brothers, an Australian family of surfers, sculptors and designers, who have been making surfboards since the 1970s. Today, the Webber brand is known throughout the surfing world, with a reputation built on innovative designs reflecting the family's avant-garde values and uncompromising creativity. Their portfolio includes surf films, surf stories, surfing trophies, surfboard fins and wave pools – all inspired by their love of surfing. Their website can be found at www.webber.net.au. Additionally, Daniel recently established a wiki encyclopaedia of surfing, called *Surferpedia* (www.surferpedia.net). He has recently completed a Masters thesis in Linguistics at Aalborg University in Denmark and lives with his two young children on the north coast of New South Wales.

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