Fred Sandback's works are well known for the impressive effect they create with the most minimal of means: acrylic yarn stretched into simple geometric configurations (Fig. 1). The taut lines draw out sharp outlines in the gallery space, in striking, simple U and L shapes. Visiting a Sandback installation, one can readily observe the way in which people treat the virtual plane created by the yarn and hesitate in crossing it. The forms created by the string have a kind of presence that viewers quickly register. Art critic Yve-Alain Bois describes the effect well:

Seeing a bunch of schoolchildren go out of their way not to cross the various thresholds that Sandback had laid out for his survey at Dia (in Chelsea) a few years ago, all behaving as though the virtual transparent planes delimited by the roped edges might electrocute them, I was convinced that the kids' caution had nothing to do with the "do not touch" warnings they had heard again and again during their cultural field trips. I vividly remembered my initial shock in seeing Sandback's work at Dwan's more than three decades ago, during my first trip to New York. Like the children, I was dumbfounded [1].

Sandback's sculpture is not simply about this strange substantia
tiality but is also notable in achieving it with such minimal means. Art historians and Sandback himself, as we shall see, fear reducing the artist's work to this phenomenon and, for this reason, have tended merely to note it and move on. However, such illusory planes are extremely pertinent to perceptual research, because there is no similar effect currently investigated in vision science. Furthermore, neglecting this effect puts in doubt any claim to a full account of Sandback's art. By studying Sandback's works closely and developing a phenomenology and perceptual analysis of them, we can better understand these works and make a contribution to the psychology of perception. In this article, I want to explore the phenomenology of Sandback's planes and also explain something of their effect based on available perceptual research.

**THE PHENOMENOLOGY OF PLANES**

Historically, Sandback's sculptures are seen as marking the end of the aggressiveness promoted by prominent minimalist artists like Donald Judd, which was both spatially imposing and materially elemental. Sandback instead withdrew from the power of presence and primal associations of materials and sought to make sculpture through the paradoxical means...
of yarn. Therefore, his work is usually noted as both material and immaterial, and as opening up space around itself. It more emphatically makes clear the conceptual element of minimalism, which in other historical strands continued to stress objecthood [2].

Sandback's own assessment of his work in his statements and writings lend further support to this position. It is well known that at Yale, where Sandback studied philosophy and art, the phenomenology of Maurice Merleau-Ponty and others was much discussed. Knowing full well the discourse of phenomenology, the artist responded in an intriguing way to a question about the sensuous presentation of his work. The journal Sans Titre asked:

A question about the second or third dimension of your work. On the one hand, there are drawings and, on the other, works like those exhibited in the gallery space. As far as the latter are concerned, can they be defined as planes or volumes?

Sandback responded:

It’s really a good question for a phenomenologist, who deals with perception, and I am not one of those. What I’m doing here is a construction of an intuitive type, so that it’s a bit difficult for me, but there is certainly a tension between the apparent two-dimensionality of the optical space and the tactile three-dimensionality of the habitual space. It’s interesting to think about it. . . . [3]

Elsewhere, he stated, “I didn’t want to make a plane of glass—that’s just one of the side effects” [4]. In other words, Sandback himself said the potential aspect of planarity afforded by his string constructions was indeed a fact of his work but not representative and certainly not the main point. These effects are basically epiphenomenal to his process.

The art-historical account of Sandback’s work has reflected the artist’s understanding of his own practice. Pamela Lee, for example, notes that Sandback’s approach to a space is highly particular, the constructions being responses to them in such a way as to “actualize” and somehow transform them [5]. Sandback does not reduce sculptural materials to essentials but exposes their fleetingness, as he manipulates forms incessantly, not settling upon a stable percept of planarity or even its absence. Rather, the spaces become perceivable through the intervention of the string installations, suggesting numerous aspects in equipoise.

In the most complete art-historical exploration of Sandback’s work to appear, Edward Vazquez explains that the planes are a kind of trope throughout the Sandback literature and should not be emphasized too much, because they risk “putting the work’s tangible yarn form in the service of the immaterial illusion and, in the process, creating a false binary of line-defining plane that stabilizes the dynamic range of presences in Sandback’s work” [6]. Vazquez explores the perspectival shifting in the artist’s work, placing equal emphasis on the stereometric forms and the spaces they imply. Perspective becomes a more accurate metaphor for balancing materiality and immateriality, keeping the endless play in Sandback’s work at the forefront.

For example, in an untitled installation from 1976 at the Annemarie Verna Galerie in Zürich, Sandback had two U-shaped forms meet each other perpendicularly.
While one could occasionally appreciate two planes simultaneously, when one faced the U shape bisected by the other, it became a simple rectangle form with a vertical element (the other U shape seen from the side). Sandback designed the installation in such a way that it could only yield intermittent illusions. This interplay is indeed lost in overemphasizing the planes. In spite of these qualifications, it is clear that the planar effect remains and is spontaneously remarked upon in Sandback’s work. Because it is regarded as misleading in an art historical context, it perhaps has been neglected in a psychological sense, leaving it undertheorized. This article addresses this lacuna by looking to phenomenological and perceptual features of the phenomenon of illusory planarity to understand it better. I show below how a perceptual characterization can indeed remain true to the art-historical account.

ILLUSORY PLANES

A common statement made of Sandback’s installations is that they sometimes appear like planes of glass from a distance, but the “plane” is not just that; it can be mistaken for a material object. This impression lessens as one approaches the installation, and the recognition of the microtexture of the string definitively destroys the initial impression. When there are installations in series, one can actually experience the effect without moving. In the installation at Dia Beacon, there are vertical lines in series, where the near ones look absolutely like string, the intermediate ones have a weak planarity effect and the most distant ones appear like relatively solid planes.

In addition, unlike the closed rectangles just described, one can observe that open shapes, like the L and U shapes, have a variable illusion of planarity relative to the closed form. The hard edges promote the illusion, but the open areas (the open part of the L or the U) dampen it. Intriguingly, in a series of drawings Sandback made in 1990, all untitled, he incorporates compact shading near the line, which then lessens as it fans out [7]. The line becomes the origin of a kind of “force field.”

I am calling Sandback’s planes “illusory” based on an analogy to a well-known perceptual phenomenon, the Kanizsa triangle. In 1955 the Italian researcher Gaetano Kanizsa devised an illusion in which three corner units induce a strong impression of a contour [8,9] (Fig. 3). Kanizsa called them “quasi-perceptual;” and others have called them “subjective” and even “cognitive,” to stress the subject’s contribution to the illusion as a kind of problem-solving. Whether we pursue a “nativist” or more “inferentialist” explanation, there is an easy argument that Kanizsa’s stimuli induce contours where there are none and Sandback’s stimuli induce planes where there are none, transposing the phenomena into three dimensions.

What is significant about Kanizsa’s triangle is not just that the triangle is induced but that phenomenological differences accompany it. The triangle becomes “figure” to the “ground” of the page. The triangle appears closer to the viewer and brighter than the ground, and lightness illusions often accompany such figures [10]. Research on Kanizsa’s triangle has spawned a number of investigations on the brightness and appearance changes that accompany such a virtual figure.

Moving into the third dimension raises issues of ecological validity, because James J. Gibson argued that the kinds of illusions that Kanizsa discovered were “pictorial” and would not be noticed in the third dimension with a mobile viewer. However, other researchers have noted the robustness of such illusions, even in stimulus-rich environments [11,12]. More recently, Steven Lehar [13] illustrated a Kanizsa illusion in space (Fig. 4), with a stimulus that was manipulable by hand. The edges of the induced triangle still pop out but now actually float in real space. In addition, in the naturalistic features of the real world, one observes the same qualitative differences between an induced triangle, which is more compact and substantial, and the environmental “ground” behind it.

While viewers routinely note the sense of phenomenal

Fig. 3. Kanizsa triangle—illusory figure induced by two sets of lines and circles. (© Ian Verstegen)

Fig. 4. Three-dimensional Kanizsa triangle fabricated by Steven Lehar. (© Steven Lehar)
planarity in Sandback's sculptures, there is no strong figure-ground illusion in the sense that the figure has qualities of compactness and outside airiness, and there is certainly no sense that the planes are phenomenally brighter (or darker) than the ground. Nevertheless, planarity itself is a phenomenal quality that differentiates the internal space from that outside it, even if the effect is not as strong as with the Kanizsa triangle.

There is one more noteworthy effect to discuss. In Sandback's installation at Dia Beacon, there are two very large rectangles "leaning" against two different walls (Fig. 1). One is made of blue yarn and the other of green yarn. The plane formed of the green yarn seems to look more emphatically like a pane of glass, perhaps because manufactured glass, with which many of us are familiar, appears to have a dark green edge. If this is indeed a knowledge effect, our familiarity with such glass can affect our actual phenomenology of the experience's illusory plane [14].

It is worth thinking about figure and ground a little more, however, because the Gestalt psychologists posited it as a limiting condition of perception. The single mark breaks the lack of differentiation of a phenomenal ground, setting up a relationship of brightness, allowing for perceptual orientation by the organism. In a real sense, the string is a limiting condition of perceiving space. Rudolf Arnheim had argued that when a line on paper stands for something, it is a "thing line" [15], and the same can be true in space. If standing for a figure, the line is not a replication of a very thin person but an equivalent of thingness, or personness.

This is the basis for many critics' idea that Sandback, in contrast to his minimalist peers, explores the very minimal conditions of objecthood. If a single string can be an individual object with a long axis—a person—a construction of string can suggest a volumetric object or contained space. It is the minimal stimulus condition for differentiating object from space, for seeing something as object at all. Of course, gestalt figure-ground stimuli are not things and neither are strings, which is the point. They are the preconditions of things.

At this point it is possible to return to the art historian's warning to avoid reducing Sandback's constructions to illusions of planarity. As has been pointed out, there are times when the phenomenal planes are strong and others when they are weaker, or overtly frustrated. The very nature of the U or L shape—regardless of one's orientation to the other—guarantees that the illusion is strong near the inducing elements, the closed contours, and weaker where the circuit is interrupted. When a U shape terminates at the top, into the ceiling, or where L shapes open up between the two lines, with no other line, the illusion dissipates. Seen as partially local illusions, the sculptures illustrate the balance of global and local processing.

Such contrasts of processing can be seen in how we look at so-called impossible figures, like the broken Necker cube [16] (Fig. 5). One vertex is not completed, which impedes the reading of depth to one axis. We can see the cube pointed up and right with no problem, but when we try to follow it downward to the left, we hit that broken vertex, and our perception of the figure is frustrated; a locally sampled percept was shut down by an impossible global percept. Compared to Sandback's sculptures, we could say that the illusion is strongest where lines meet and then lessens away from them. Looked at from the top, a U-shaped configuration does not suggest planarity. Looked at from the bottom, it does. Attempting to follow the plane along its length, we discover that its phenomenal planarity peters out and disappears.

Impossible figures help us understand the construction of visual percepts. Global cues suggest wholeness; local cues overturn them. This, then, is the lesson of Sandback's phenomenal planes. It is only when we grant their full illusionism that we can appreciate the artist's efforts to vitiate them. The planes are real, but they come and go. The secret, as with an impossible figure, is not the realized percept but its interplay, its apparent fullness and undermining. In this way, the perceptual psychologist's account of Sandback's string constructions is not out of place but can contribute to enlightening the way the artist has fully manipulated the constructive aspect of space creation.

To summarize, strings induce subjective planes much in the way that figural elements can induce subjective contours in the Kanizsa illusions. Yet because Sandback does not create unqualified illusions, but has them reinforced in some elements and not in others, the bottom-up and top-down clash of percepts is reminiscent of impossible figures. The analysis in this article allows us to join a perceptual account to an art-historical account. Instead of quickly passing over the induced planes as misleading of Sandback's intentions, this explanation actually reinforces the larger point of Sandback's sculptures.
References and Notes


10. For a review, see L. Spillmann and B. Dresp, "Phenomena of Illusory Form: Can We Bridge the Gap Between Levels of Explanation?" Perception 24, No. 11, 1333–1364 (1995).


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