

Viewpoint

Imagination's hand: The role of gesture in design drawing

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The eminent architect Thom Mayne was in a bombastic mood the evening he lectured at Carnegie Mellon University's School of Architecture several years ago. 'Drawing is dead,' he pronounced, pointing to its displacement by digital media in current practice. Yet throughout his talk, he used skillful thumbnail sketches in real time on an overhead projector to explain his projects. Besides the obvious contradiction, what caught my attention was the flowing, varied, and expressive line character of his drawings: their *gestural impulse*. This is a characteristic shared by both figure drawing and the exploratory drawings of many accomplished architects. A developmental section by the noted Australian architect Glenn Murcutt illustrates the point (see [Figure 1](#)). Note how his line seems to freely roam the drawing's interior.

Taking up Thom Mayne's challenge, it is past time for an unsentimental appraisal of the contribution drawing by hand has made (and can still make) to design. There is support for this across a broad spectrum of opinion: researchers in design cognition who point to its value for good design process, architects who complain about an absence of spatial imagination among new recruits (who cannot draw), and advocates for CAD who now recognize shortcomings in their media.

The focus here is on one aspect of hand drawing's contribution, its gestural content: the expressive action of the hand itself as it moves through a drawing. Stretching back over years of teaching drawing to students of architecture, I have introduced the topic with the spatially expressive figure drawing exercises of the well-known teacher/author Kimon Nicolaides: *The Natural Way to Draw* (1941). I have followed these with applications of similar techniques to architectural subjects (see [Figure 2](#)). And over these years, I have observed what has seemed to be a connection between the free gestural mark I find in the drawings of some of my students and their design ability. Those whose drawings have gestural fluidity also seem to be better designers. If true, what might this observation tell us about today's professional and educational practices—with designers and students drawing less and less by hand, and many not at all?

Kimon Nicolaides taught drawing for 20 years at the Art Students League in New York during the 1920s and 30s, a time of great experimentation in education generally; Maria Montessori, Rudolf Steiner, and John Dewey were contemporaries. One idea shared by all of them was a focus on learning by doing, and for Nicolaides in teaching drawing, that meant a focus on the physical act itself: the hand in motion.

The central element in Nicolaides' teaching—it has long been featured on the cover of his book—was the exercise he called *Gesture* (1941: 14–20) (see

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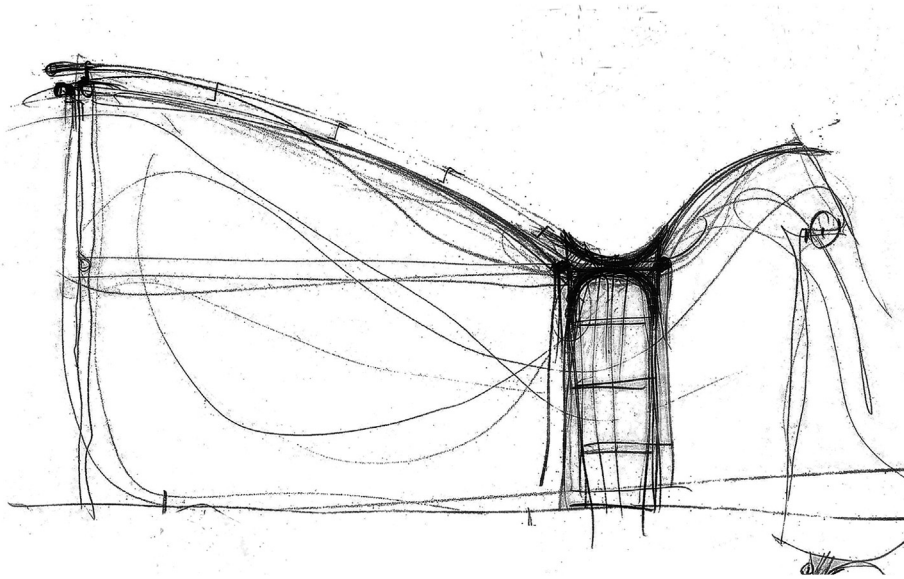


Figure 1 *Magney House*, Glenn Murcutt, architect

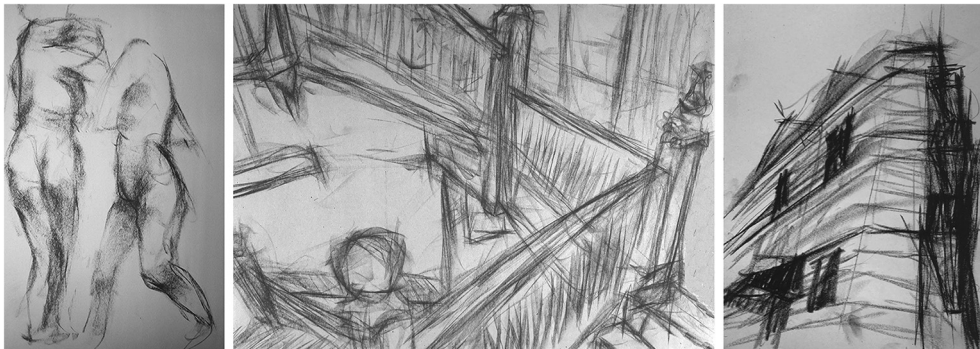


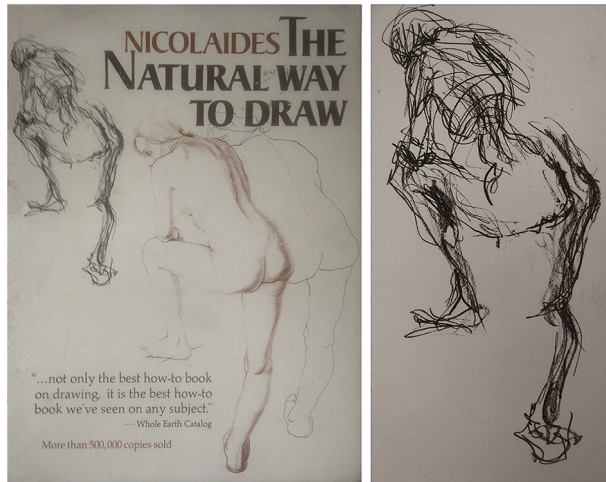
Figure 2 From figure drawings to architectural studies, (left) Misha Varshavsky, (middle) Brian Leet, (right) Vincent Chew

Figure 3). The purpose and methods of gestural drawing are fairly straightforward. We seek the essence of the model's pose—the direction and resolution of forces in an athletic stance for example—and with this intention our marks linger in some places and move quickly in others. There is constant back and forth between eye and hand. The hand responds to the pose; the eye interprets what the hand has proposed; subparts in the drawing are revisited and modified regularly. Some marks are smeared away; others receive increased

emphasis. Gestural drawing searches for form without knowing it from the outset: that searching reflected in the mark's variation of detail, pressure, and speed.

Nicolaides developed the elements of gestural drawing through two exercises: *cross contour* and *modeling*. As with all of Nicolaides' exercises, these foster a haptic connection with subjects, one arising as much in touch and movement as vision. *Cross contour* focuses on a subject's surfaces,

Figure 3 Cover image and detail from *The Natural Way to Draw*, by Kimon Nicolaides (Boston: HMH, 1961). Used by permission of Houghton Mifflin Harcourt Publishing Company. All rights reserved



edges, and shapes (see Figure 4 left). We imagine we're touching these and use line to trace the path our eye might follow if moving like a fifth limb along and across these attributes (1941: 9–14). *Modeling* addresses them as well, but more as a sculptor might (see Figure 4 right). First, we build our subject's mass; then, we shape it: depressing and releasing surfaces as we would if manipulating clay (1941: 36–39). Variation of the weight of the marks is constant. *Cross contour* contributes more to a mark's expressive spatial

movement, *modeling* to its changes of emphasis, levels of precision, and ambiguity.

Though long appreciated for the physicality of his approach to drawing, with his gestural exercise, Nicolaides takes expressiveness to a new level. His instructions ask us to use our hands to empathize with our subjects. If drawing a boxer throwing a jab, we are to feel the force and sting of that fighter's punch. In essence, we are asked to *inhabit* what we draw, a word with an obvious

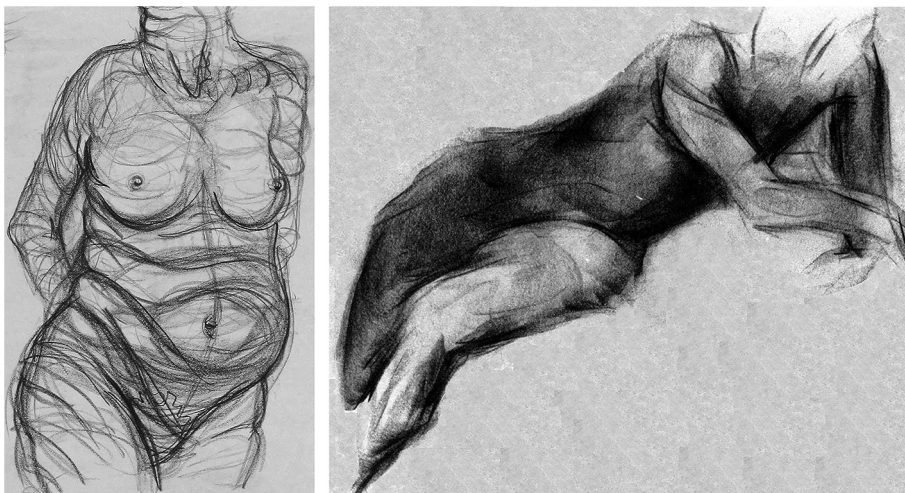


Figure 4 Cross contour and modeling exercises, (left) Misha Varshavsky, (right) Andreas Petruscak

relationship to the space-making task of an architect. In sum, through the activity of drawing, Nicolaidēs was seeking no less than a foundational connection between the activity of the mind and the experience of the body in understanding and depicting space.

To my knowledge, the relationship of Nicolaidēs' pedagogy to current thinking within embodied cognition about the body's role in spatial visualization has never been examined; but there is good reason to do so because both seem to share the same underlying insight. As a theory, embodied cognition recognizes no fundamental division between body and mind, considering each an extension of the other, and many of its researchers have pointed to a connection between hand gestures and spatial thinking. My intention here is to pair their research with Nicolaidēs' approach to figure drawing and then consider what the two together might say about the value for the designer of the kind of hand drawing he advocates. Relating the two may position us to identify those characteristics of hand drawing that still make it valuable as a design tool, even in the digital age.

So, how will this essay add to the considerable research of others who have been looking at the topic of hand drawing's role in architectural design? In the last 25 years, its use has changed markedly. As Thom Mayne pointed out, CAD has largely supplanted it for representing buildings during design development and for producing final construction documents. And yet, design process researchers point to a critical role freehand drawing still seems to play for many. These are some of the reasons they cite.

Part of it is simply a matter of the speed and versatility with which hand drawing can generate a rich tableau of multiple views: plans, sections, and perspectives all set next to one another and sometimes annotated with notes. According to Nigel Cross, this kind of side-by-side presentation

often leads to unintended discoveries when one drawing is newly seen in the context of another (2007: 25–39). A significant contributor to this dynamic is hand drawing's capacity for representing both abstraction and ambiguity.

'Sketchiness' is very simply in the nature of hand drawing, and, as Barbara Tversky points out, it is this quality that fosters surprising insights (2015: 220). It helps keep multiple design outcomes in play during the early stages of design. As I described in reference to Nicolaidēs, active marks set up a reciprocal process between a designer and a drawing: the hand approximates and the eye discovers. Another way of putting it is the phrase Gabriela Goldschmidt uses: 'seeing as and seeing that.' That is, hand drawing offers the designer a mode of presentation that displays both the current state of a design and affords its change (1991: 131–38). For Nigel Cross, this characteristic of abstraction combined with ambiguity is ideally-suited for the 'ill-defined and ill-structured' nature of design problems (2007: 35–36).

But though many point to the usefulness of this quality of drawing, there is little in the literature about how to create it. After all, some drawings are richly suggestive of multiple outcomes, but others are not, and here the perspective of a drawing teacher can make a real contribution. For this *how* question, the pedagogy of Kimon Nicolaidēs, with its call for nearly constant shifts of line character and weight, has much to offer. Constant variation of mark will be shown as a key element in sustaining the difficult balance between clarity and suggestiveness that give drawing its transformative power.

In the literature, there is also discussion of the act itself: the hand in motion. The aforementioned Barbara Tversky, who addresses spatial cognition generally from the perspective of embodied cognition, gives gesture a central role in spatial visualization (2011: 499–535). And there is a strong implication of its importance in Gabriela

Goldschmidt's conference presentation, 'The black curtained studio: Eulogy to a dead pencil,' which focuses on a single element of traditional design instruction in architecture schools: the desk crit employing hand drawing (2012: 1–21). Specifically, she's referring to the practice of a professor's drawing over top of a student's design, while both participants talk with one another about that design. She reports that it is being used less and less in studios nowadays. In its place, professors are adopting a practice of offering verbal criticism to students while they peer jointly at screen displays and rarely draw at all. And in so called 'paperless studios,' desk crits using any element of hand drawing have nearly vanished altogether.

She describes this currently undervalued traditional practice of drawing during design critiques as a 'two-channel communication,' one that has combined conversation with 'spatio-visual action' (2011: 2). Its increasing absence today, she argues, is depriving students of the kind of demonstrative coaching that has been at the core of studio instruction heretofore. Importantly, for our focus on gesture, her way of putting this—'spatio-visual action'—points directly to the role of the movement of the hand itself in the transaction.

So, in its focus on hand gesture as an issue of design drawing, this paper will not be breaking entirely new ground; we will be looking at a subject that others have already pointed to.

However, by bringing embodied cognition's research on hand gestures to bear on Nicolaides' pedagogy, this essay will add to our understanding of *why* drawing by hand while designing brings such rich spatial intelligence to the effort.

1 Relationship between design and gestural drawing

Is there evidence to support a correlation between skill in gestural drawing and design skill? With this in mind, several years ago I reviewed my first-year students' drawings of classical statuary—49 students in all—and evaluated the gestural character of their line work in five categories: very strong to very weak (see Figure 5 for samples of this scale). I was looking for two characteristics: 1) a flowing and full sense of surface and volume and 2) variation of line weight and character. Later, I asked their then current architectural design studio instructors to independently assess the design abilities of those same students. Their evaluations were based on interaction with them over a six-week period in which the students had used three-dimensional study models and few drawings. Because it would measure capabilities of imagination and visualization in design independently of drawing ability—designing using three-dimensional models in their course and a gestural mark in mine—I thought the comparison of the results would be more reliable than it would have been had both courses used drawing in significant ways. I asked the instructors to use the same scale I had used. Then I compared the results.

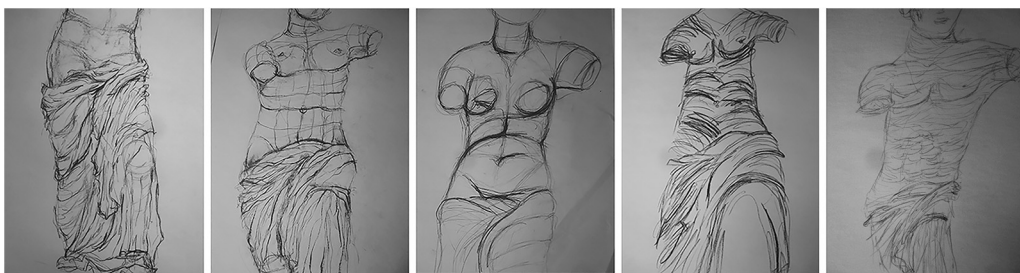


Figure 5 Examples of student drawings of sculptural pieces rated for expressiveness of line: five categories strong to weak, left to right

There was a 78% match, either the same grade or one grade difference on the five-grade scale, between my rating of students for the gestural character of their drawing and those of their design instructors for their design skill. I found this result sufficient to suppose a correlation between the two: sufficient, that is, to begin developing a theory from the literature in embodied cognition on hand gesture as to why it might be so.

1.1 What does embodied cognition say about hand gestures?

Is a gesturing hand engaged in spatial thinking? Multiple researchers in embodied cognition, Robert Krauss, Ezequiel Morsella, Frances Rauscher, and Richard Wesp, among others think so. They offer compelling evidence that hand gestures we routinely use in describing spatial conditions, giving directions to a stranger in a city for example, also assist our spatial imagination about those subjects. Further, they find that the more complex the subject, the more we tend to gesture. Their research is relevant for our subject because, if we could establish that what they have uncovered regarding hand gestures could also apply to design sketches, then we could claim that a more gestural character of mark also strengthens the spatial imaginations of designers while they draw. Here are two examples of what they were pointing to in their research from my own observation; both

appeared to use hand gestures to assist spatial thought. Consider:

My wife Stefani and I were looking at a quilt she was working on. She had laid it out on the floor so we could discuss potential reorientations of some of its shapes. Suddenly, in the moment she began speaking about those options, her hands and fingers began to move in mimicry of those potential new placements (see [Figure 6](#)).

My daughter Sarah (then 6) was eating a breakfast of pancakes and maple syrup. She was talking about rollercoasters. We were rushing to get her to the school bus on time; so, while she was talking (and eating), I was under the table tying her shoes. Over the preceding weeks, she had been making drawings of rollercoasters one after the other. For her it was a kind of design exercise; she knew my discomfort with riding rollercoasters and had been using these drawings to discover one we might ride together. Once, I happened to look up from beneath the table, and I could see from the movement of her elbow that she was drawing the rollercoaster in the maple syrup with her fork while she talked about it.

For Stefani, the abruptness with which she began moving her hands in the moment she started talking about alternative compositions for her quilt



Figure 6 Suddenly, Stefani began moving her hands and fingers in mimicry of the shapes in the quilt

would seem to indicate an integral connection between the movement of her hands and her spatial thinking. From Sarah's rollercoaster, we might easily conclude that gestures are more important for the one making them, than for the one observing them. After all, I could not have seen her hand move; I was under the table. What then do gestures do for the one who gestures? The contribution Morsella and Krauss reported is that gestures help spatial thought by sustaining it in working memory (2004: 411–24).

How might this work? In experiments paralleling those of Morsella and Krauss, Wesp et al. likewise found gestures assisting recall of absent images, and in addition they mapped them into Baddeley's well-known model of working memory to explain their role (2001: 592–3). With his model Baddeley had suggested spatial information might be held briefly on what he called the 'visuospatial sketchpad' (1986). Wesp et al. argued hand gestures serve to maintain spatial information by preventing its 'decay' (2001: 592–5).

There is disagreement among researchers about the nature of the relationships among spatial imagery, gestures, and words. They all agree that gesturing helps; it's more a matter of what precedes what. Rauscher et al. proposed that conceptual knowledge about spatial constructs prompts gestures, and then gestures prompt speech (1996: 226–31). Krauss found gestures serve to help verbal thought through a process of 'cross-modal priming' (1998: 55). Wesp et al. believed the motor image precedes the spatial thought. They wrote: 'Spatial imagery is the concept before and during lexical encryption, not the result of lexical encryption. We believe that gestures are not directly involved in the search for words; rather, they keep the non-lexical concept in memory during the lexical search' (2001: 592).

What could this indicate about the role of gestures in spatial imagination? Returning for a

moment to Sarah's gesture/drawing of the rollercoaster, if we would agree with Wesp et al., we could conclude that for Sarah to talk about her rollercoaster spatially—possibly even to imagine one at all—she needed to move her hand like one or draw one first, however briefly. Further, we would observe that these acts would have not only sustained Sarah's spatial thinking long enough for her to speak about it, as the others would agree, but, if we would agree with Wesp et al., we would find ourselves saying: it was the gesture itself (and the drawing in the maple syrup) that would have initiated the spatial character of her thought.

For Stefani, the relationship of her hand movements to her spatial thought would have been somewhat different. Though she did not have to imagine the quilt—it was already there at her feet—she did have to imagine (and hold for a moment in working memory) its possible alterations. The point I want to make here is this. Despite their differences, both instances shared the same instrument as a source for their spatial thinking: for Sarah's rollercoaster, a moving hand to create it, and for Stefani's piecework, a moving hand to initiate possible changes in its composition.

1.2 Is this research relevant for hand drawing?

So, if we can accept what embodied cognition says about the contributions hand gestures make to spatial thinking, does that mean a similar level of spatial content would come from hand movements that are natural to hand drawing? Are the two somehow functionally equivalent?

Short of applying the same level of research to gestural drawing as that conducted by cognitive scientists into everyday hand gestures, there is research reported by Zafer Bilda, John Gero, and Terry Purcell in their paper, 'To Sketch or Not to Sketch' (2006), that appears to support a claim that the two, hand gesturing and hand

drawing, parallel each other in supporting spatial thinking. Their paper compared the quality of designs produced by three experienced architects under two circumstances: 1) when they were allowed to sketch while designing, and 2) when they were blindfolded and prevented from sketching while designing. The projects in both instances were small houses with simple programs. The designs produced without sketching were presented in drawings the architects produced quickly at the conclusion of their process to show what they had already worked out in their heads.

Of interest, the results for this small project were that sketching or not sketching did not seem to influence the quality of the designs at all. In a double-blind judging, a panel of three teacher/architects with more than fifteen years of experience found the work more or less equal in all the categories they evaluated (including inventiveness, practicality, and flexibility) whether the designs were generated by a process that allowed for sketching while designing or not.

However, there is more revealed by this experiment than just the equality between the design results. Detailed observations about the experiment made by Barbara Tversky show that an equivalence between hand gesturing and hand drawing would be consistent with and very possibly explain the equality of those results. Blindfolding the architects and preventing them from drawing, as she notes, also ‘led to copious gesturing, actions in space that mirrored the design ideas under consideration.’ In other words, their ‘gestures did at least some of the work of sketching’ (2015: 220).

So, why not just gesture? Why bother to sketch at all? For Tversky the principal reason for using sketches, rather than just gestures for spatial thinking, is that sketches are more ‘permanent than gestures ... they offload memory’ (2015: 220). Both the comments made by the three

architects afterward and Bilda, Gero, and Purcell’s monitoring of their subjects’ cognitive activity while blindfolded pointed to the same observation: how taxing the memory task became after the first 20 min of designing (2006: 607–08). But within that 20-min span, given Tversky’s observations of the important role hand gesturing appeared to play in the architects’ design process, it seems reasonable to conclude the two are functionally equivalent to each other in their contributions to spatial visualization.

What then can we say about *gestural drawing*? I’m thinking of a hand moving in the way Thom Mayne moved his during his lecture, one moving more in the manner of some of my better students in drawing statuary. There is a leap that needs acknowledgment here, one that goes beyond what Tversky’s comments could support. For here in this paper, I’m not just pointing to the value of drawing in general (what Tversky discusses). As I’ve already outlined, I’m proposing a manner of drawing built on Nicolaides’ understanding of what constitutes *better* drawing. As part of that, I’m arguing that mark-making that is more in touch with form and more empathetic with it is inherently more spatial.

1.3 Three-dimensional gestures/two-dimensional drawings

There is an objection that might be raised to my relating the research pertaining to hand gestures, which are three-dimensional in nature, to hand drawing, which is two-dimensional. I think the key to understanding the connection I’m making—and specifically the relationship of actual gesture to gesture in Nicolaides’ pedagogy—is found in the degree to which he envisioned drawing as a three-dimensional rather than a two-dimensional activity.

I’ve already discussed the exercise he called *cross contour*. But actually, he had two versions of the exercise, which he introduced as a sequence. The first he called *full cross contour* (see

Figure 7 left). In this he asks us to draw things in the *full round* by drawing contours not just across the visible surfaces facing us, but around their backsides as well. Quite literally, he wants our marks to envelope form in a full embrace. In Figure 7 right, we can see a more elaborated example of this full-round sense of volume and surface in one of my students' anatomical studies. Only after completing this more three-dimensional first step, does he want us to proceed to *cross contour* where we draw only the visible side.

A similar degree of three-dimensionality is found in the exercise Nicolaides called *modeling*. I've already described it as fundamentally sculptural, but its three-dimensional core is best understood by comparing it to low-relief sculpture. The masterpiece for which the early Renaissance, goldsmith and sculptor, Lorenzo Ghiberti (1378–1455) is best known is the set of doors for the Baptistery of St. John in Florence called the *Gates of Paradise* (see Figure 8), which is comprised of multiple low-relief images. We should observe the degree to which the third dimension has been condensed in these reliefs

because, although they represent scenes of great depth, they have compressed that depth to a matter of inches.

When introducing the *modeling* exercise to my students, I have found it useful to compare what they are about to undertake to works such as these by Ghiberti. It's a small step, I find, to bring my students' understanding of the exercise from the one to the other. In modeling form, I explain to them, we are merely reducing our subject's actual depth yet a step further than Ghiberti already did; the sense of space and surface is fundamentally the same. We press background elements into the background and release foreground elements forward, just as he did; we establish edges by varying hand pressure, just as he might have done in carving the originals from which his molds were cast.

In Figure 9 we see three examples of this *low relief* approach to drawing. In the one at the left, surfaces are pressed into the page to form an architectural opening. In the middle, we see space pressed into the background to allow a pipe railing to advance forward out of the page. At

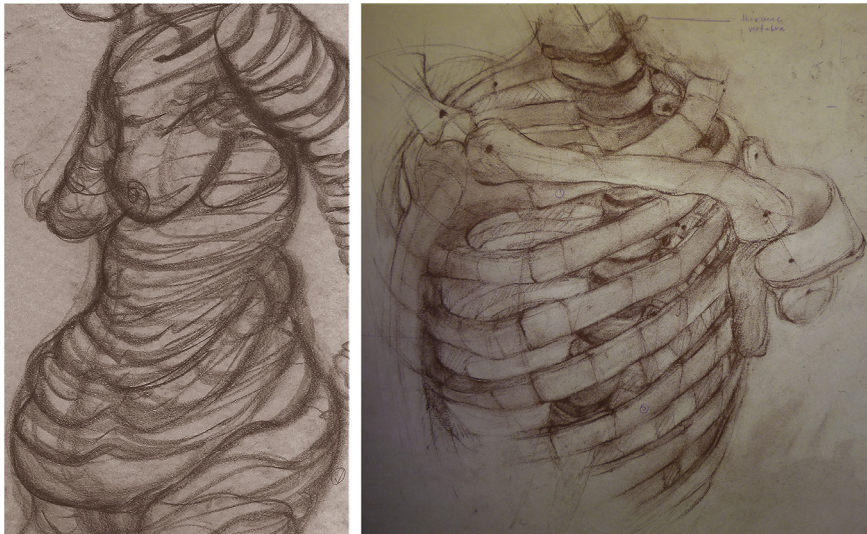


Figure 7 Full cross contour exercise, (left) Allison Lukacsy, (right) drawing of the thorax, Ji Hee Hwang

the right, we see the underside of a ramp pressed between cantilevering beams.

So much of what Nicolaides wrote about the subject of drawing is directed at our capturing the *realness* of things rather than just their appearance—their weight, their mass, the movement of their surfaces—their properties as three-dimensional objects. And now we’ve just seen the degree to which the movements he asks us to make while doing his exercises also mirror real movements in three-dimensional space: whether in surrounding form or sculpting it. It is this three-dimensional core understanding that helps us bring the three-dimensional world of gesturing, our muscular and motor experience of the world around us, into the constrained and two-dimensional world of hand drawing.

2 Gestural drawing, contour, and making proposals

So, what could this more expressive hand that Nicolaides advocated many years ago bring to the spatial thinking needed for design? [Figure 10](#) shows two drawings that illustrate something of the life it brings. At the left is a

figure study by one of my students; at the right is a developmental drawing by Lou Kahn for the un-built Dominican Motherhouse. Both engage the hand’s capacity for vigorous mark making, and in both we find a slashing mark used to surround and make volume. In essence, both are instances of Nicolaides’ contour exercise—they move around volume.

What capacities does an expressive hand bring to these drawings? I propose there are two. 1) Through its ability to imitate shapes that were experienced once, it brings a capacity to generate new ones. 2) Through its ability to move through the drawing, it brings a capacity to experience what has been shaped, in effect, to test it. That is, it brings a pairing of creation and enactment. Here’s an example of what I mean.

About the same time Sarah was drawing all those rollercoasters, I found the opportunity to watch and record her while she drew a playground slide (see [Figure 11](#)). She started by making a curling sliding board. Then, with her marker, she repeatedly traveled up and down the slide and climbed its ladder. Her speech and her marks—note the



Figure 8 Lorenzo Ghiberti (1378–1455), Gates of Paradise, 1424–52, Eastern doors of the Baptistery of St. John, Florence, from a facsimile version, Carnegie Museum of Art, Pittsburgh, PA. Photograph by the author

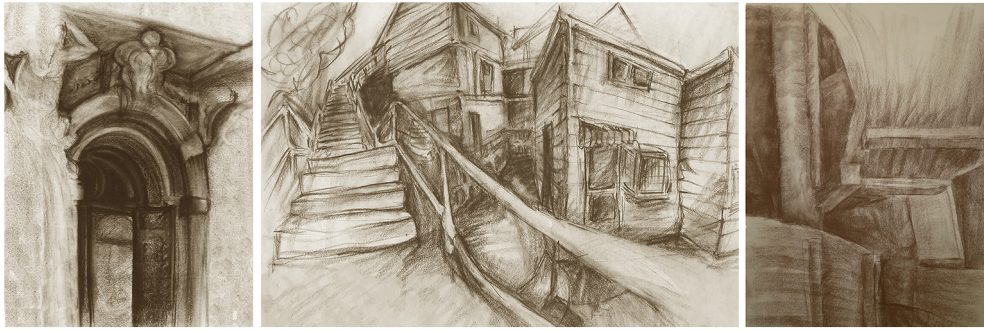


Figure 9 Modeled drawings, (left) Frederique Turnier, (middle) Yoonsun Yang, (right) unknown student



Figure 10 (left) Contour/modeling study, Eugene Jahng, (right) developmental plan, unbuilt project for the Dominican Mother-house 1967, Louis I. Kahn. 030. I. C. 700. 010. 36, Louis I. Kahn Collection, University of Pennsylvania and Pennsylvania Historical and Museum Commission

repeated curling marks and dots on the ladder—establish the relationship between the two: creating and using. First, she makes the slide; then she climbs up to it and slides on it.

Do we see a similar pairing of proposing and enacting among the drawings of architects more generally? Although we cannot be there to watch what truly happened during their production, here are several drawings by practitioners that seem to point to the same paired relationship:

In his early drawings for the Beverly Hills Civic Center, Charles Moore used a gestural line to shape a series of exterior spaces into a spatial sequence along an axial path (see Figure 12).

Subsequent marks seemed to occupy the site his earlier marks had created: moving along a meandering path past the oval shapes at the edge of the same space and then ascending a set of zig-zag stairs at the upper right.

Glenn Murcutt's sectional study of the Marika-Alderton House (see Figure 13): after shaping the enclosure, Murcutt's marks seemed intent on animating its space with anticipated movements of seasonal breezes, window awnings, and sun angles.

Lou Kahn's developmental plan of the Morris House (see Figure 14): here we see vigorous marks used to differentiate levels of spatial



Figure 11 Sarah Cooper (6) drawing a slide

definition—lighter ones for a garden wall and heavier ones for solid walls. Then, like Murcutt and Moore, Kahn appeared to move through and occupy the spaces he had made. Note the arrows moving from room to room and the loose furniture placements. In one notable instance, the interior courtyard, we see a flower-like shape that seems to capture Kahn's understanding of the way the space would be conceived: one with three lobes.

Third-year B.Arch student Ethan Young used pencil sketches throughout his design process

0:00 I'll make a swingset.
0:20 I'll make some children in it...in the playground.
1:40 Two children are sharing this swing.
1:45 Two children are sharing this swing.
1:50 There's a big swingset with this curling sliding board.
(as she draws the curling movement diagonally across the page)
2:05 You go back up again...and you slide
(she moves down the slide with her marker)
2:40 You go back up again...and you slide.
(she moves down the slide with her marker)
2:50 And you slide. (still moving her marker)
3:15 And you go up (still gesturing)
You go down...down...down and down. (still moving)
3:20 Daddy, how do you like that slide (she calls suddenly out to me)
I'll show you how you go up this slide, Daddy...Daddy.
You go up these stairs, (she climbs the stair with her marker; note dots)
3:25 and then you go like this, go like that, and then you curl.
(her voice fades; she seems to no longer be talking to me)

beginning with early developmental plans, sections, and framing axonometrics, and extending through construction details; all show a loose investigatory gestural mark (see Figure 15).

I could point to numerous examples of a similar line character in the work of others including Alvar Aalto, Renzo Piano and Carlo Scarpa, and I propose there is something fundamental at work here. As with hand gestures, with gestural marks we use our bodies to both create and then experience what we have proposed. Sarah's marks proposed a slide, and then went up and down it.

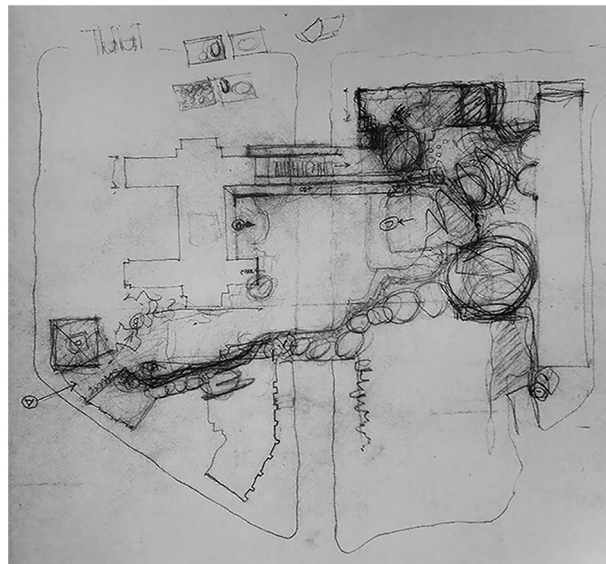
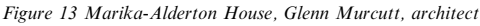
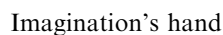


Figure 12 Beverly Hills Civic Center, preliminary drawings by Charles Moore. Used by permission of the Charles Moore Foundation. All rights reserved



2.1 Gestural drawing, line weight, abstraction and ambiguity

Figure 14 Plan for the Morris House, Louis I. Kahn. 030. I. A. 440. 12, Louis I. Kahn Collection, University of Pennsylvania and Pennsylvania Historical and Museum Commission



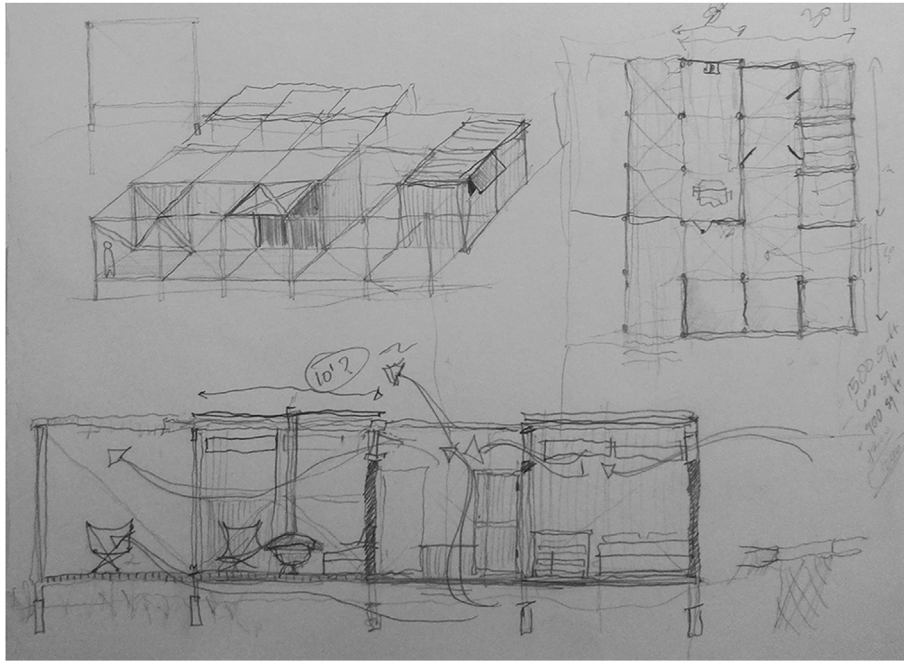


Figure 15 Studies for a third-year design project, Ethan Young, Stefani Danes, design studio instructor

of spatial thinking. But what about those junctures in the design process when too much physicality might actually hinder the process? What about those quick diagrammatic sketches architects typically use early in their process to jump-start and quickly represent an overall idea? In Figure 16 we see an architect, colleague, and friend of mine, Gerard Damiani, using a sectional study early in his design process to represent a contextual idea: a residence and its steeply sloping site. Gerard's idea was to engage the slope within the interior of the home itself; its section would mimic the slope of the land outside.

I have spoken with Gerard about the role such early sketches play in his design process, and he agrees that the following outlines their representational needs. 1) They need to avoid being overly specific about a proposal so as to avoid slowing down his thinking or derailing his idea. 2) They need to offer a stand-in for a range of outcomes so as to not preclude the many versions of the idea they might eventually uncover. 3) They

need to represent a proposal with sufficient poignancy to capture an idea.

In a word, such drawings have competing aims, and these are tied to two notions: *abstraction*, in the sense that they have to provide versions of design ideas that are reduced to essential parts, and *ambiguity*, in the sense that they have to sustain multiple readings. Omer Akin in the Appendix of his *The Psychology of Architectural Design* writes about the issues of abstraction and multiples in this way. 'There can be multiple representations of the same reality. This is because realities have many different properties or attributes and each representation abstracts only a finite subset' (1986: 186). This helps us to understand how abstraction comes to be—fewer parts standing in for more—but it does not get us entirely to the multiple design outcomes my friend also needed to simultaneously represent.

Gabriela Goldschmidt shares Akin's interest in the role of abstraction and ambiguity within the

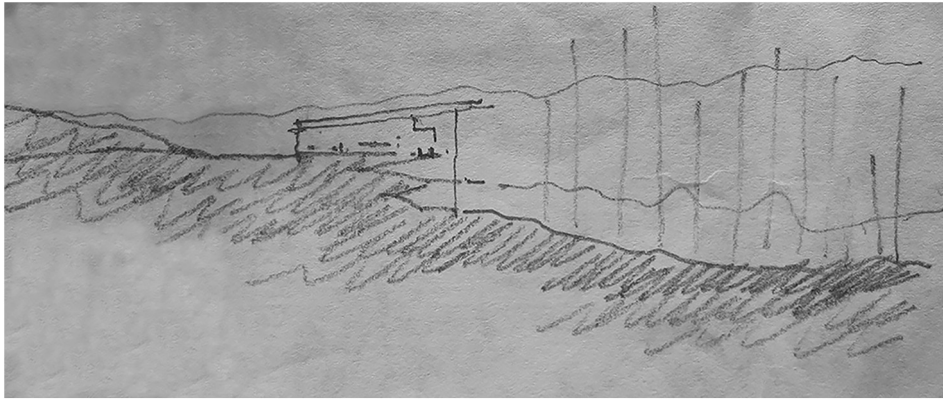


Figure 16 Sectional study for a house on a Pittsburgh hillside, Gerard Damiani, studio d'ARC, Pittsburgh, PA

design process, but she discusses the material nature of such representations in a way that leads me to conclude the following: While design drawings can retain multiple outcomes at key points in the design process through their levels of abstraction, they must also possess sufficient material richness for solutions to the problem at hand to be found among them (1997: 452). We have to keep Gerard's task in mind. His representation could not simply reduce itself to a finite set of solutions; he needed a drawing that would also suggest several possible interpretations. It had to suggest positions, sizes and materials. It had to be both spare and pithy.

The argument I make here is that a gestural mark, through its varied weight and precision is the hand's way of bringing these somewhat contradictory attributes of abstraction and ambiguity to the table. Here's a really simple example of what I mean: a line, line B in the example below,

with two readings. It can be read as continuous (like line A) or segmented (like line C); the two possible readings are created merely by the hand's action in varying pressure just a little (see Figure 17).

One thing my friend Gerard uses to add to the suggestive punch of his drawings is a somewhat tremulous line, but there is more to it than that. His lines are soft, vague even, and not overly precise. To achieve that softness, he uses a soft pencil—he never uses leads harder than F—and he often uses a paper with some tooth. In the case of his sectional study, he used an extremely inexpensive one; he did his study on the back side of a tea bag wrapper, something he keeps handy for ideas that might pop into mind unexpectedly.

Though variation and imprecision are line characteristics we associate with early sketches,

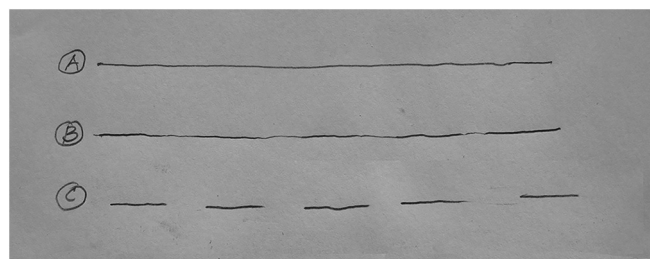


Figure 17 Studies of line and ambiguity by author

many architects find them useful even late in the design process. Last fall I visited with a former student, Ken Kuligowski, who works in a major national firm. Now that digital media are so pervasive in contemporary practice, Ken was an ideal person to consult on the topic of hand drawing vs. CAD because he is equally comfortable with both. The design phase he identified as one where he still uses hand drawing surprised me at first; he still works out construction details by hand rather than digitally. He showed me two drawings from earlier projects: one digital and one by hand. Of the two, the digital presentation is the more precise: at least as a measure of size and location (see Figure 18 left). As construction nears, precision becomes more and more important, and ultimately imprecision must be eliminated altogether.

However, Ken was describing work on details *prior* to construction documents, and for this some flux was still helpful, and too much precision might have hindered progress (see Figure 18 right). So, what Ken did with his free-hand drawing was hold the parts away from each other—note the narrow spaces left next to the elements labeled 3×12 wood lagging—so they were still free to move or change in size. In effect, Ken kept the drawing unsettled so long as his decision on its final configuration was still in play. However, we should not miss the role his line quality also played in the process. A close inspection reveals the same sort of active line that we see in Gerard's sectional study.

The best example I could point to of a designer's hand working with the eye to create and use

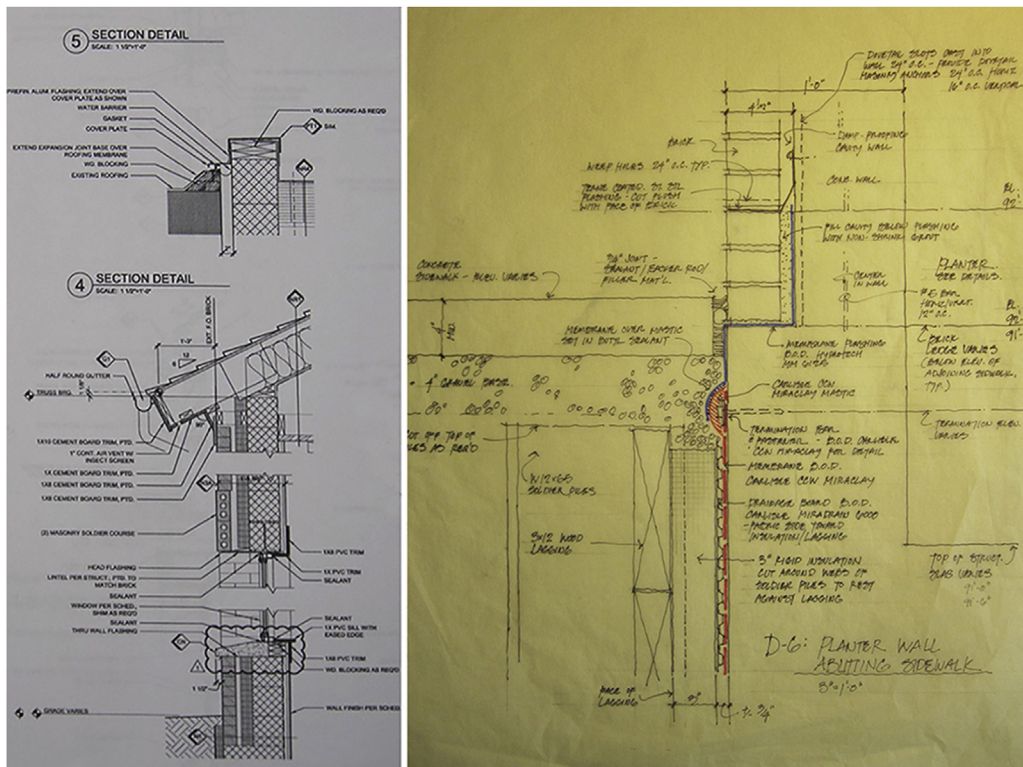


Figure 18 Construction details, Ken Kuligowski, Associate Principal, Perkins Eastman, Pittsburgh, PA. (left) Digital, (right) hand drawn in ink on trace

ambiguity is Lou Kahn. I've already mentioned his drawings for their sense of occupancy, but I've not described his use of vine charcoal on canary trace deep into his design process. I was once a student of an architect, Troy West, who was a former Kahn employee, and I learned Kahn's technique through him. I have seen first-hand what all those smudges bring to design (see Figure 19).

The marks are freehand, and they tend to vary merely as a function of the tool. Vine charcoal wears quickly. A line may start out pointed, but it quickly becomes blunt. Further, because the sticks are a bit crooked (years ago they really were baked vines, or willow), whether by intention or not, they tend to roll a bit in the hand and cause yet more variation. As we can see in Kahn's drawing, vine charcoal also smears easily, even by chance, and this causes forms and shapes to be more softly, as against precisely, delineated.

All of this chanciness should not be dismissed. As E.H. Gombrich points out, going back to Leonardo da Vinci's *Treatise on Painting*, the process of finding order in vaguely defined forms has long been acknowledged as a mechanism of creative

thought (1961: 188). Referenced by Gestalt psychologists with the word '*Prägnanz*,' there is the sense that a quality of what I might call 'becomingness' is useful because it encourages exploration and affords change. It allows for a drawing to be undertaken without knowing its final outcome: undertaken in the belief that order might be found in the course of making the drawing rather than known from the outset. However, this is not magic. The mix between abstraction and ambiguity, takes time to develop. It requires considerable practice and in the end artfulness to master producing drawings which both lack detail and precision, but have enough material quality to be evocative.

3 Conclusions: implications for the body's role

So, what does this finally portend for design education and professional practice? When I first introduced Nicolaides, I pointed to his desire that drawing have a more substantial basis than vision alone: that touch and movement be part of the experience, and that it arouse empathetic sensation for the subject. As I characterized it, he wanted his students to *inhabit* what they drew.

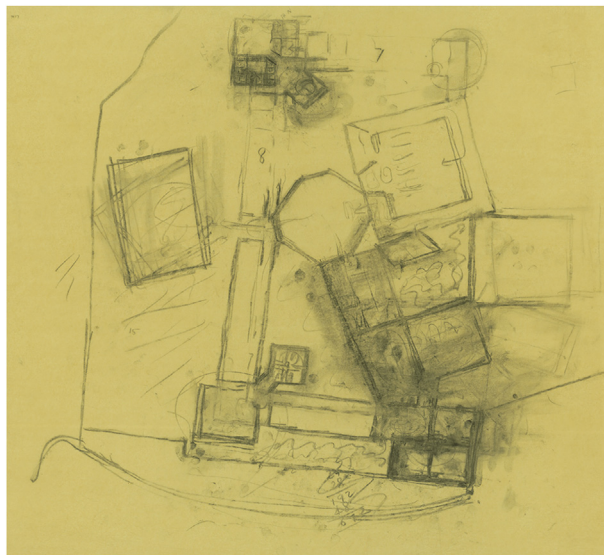


Figure 19 Developmental plan, Louis I. Kahn. 030. I. A. 700. 16, Louis I. Kahn Collection, University of Pennsylvania and Pennsylvania Historical and Museum Commission

Years later, a recent paper on the field of protein crystallography by anthropologist Natascha Myers offers an example of a similar understanding of the body's empathetic role in spatial thinking (2008: 163–99). Myers reported on the work of a chemistry professor named Diane, head of a protein crystallography lab at a major research university. Over several years prior to the study, interactive digital models had supplanted the physical models her students used to construct by hand. Despite the obvious advantages of these new models, Diane had found that they hindered her students' understanding of the three-dimensional structure of the protein molecules to such an extent that she had found it necessary to intervene in their process.

So, she arranged for her students to view their digital models stereoscopically. By doing so, she enabled them to *feel present* within the spaces of the molecules they were constructing, and so reach a better understanding of their structure. And, as if in affirmation of the body's central role in building their understanding, Myers reported that these students also gestured and moved their bodies constantly as they built their models.

In related exercises that I use to introduce my students to the projection of architectural space

using axonometry and perspective, I also find it useful to engage their bodies as much as possible in locating points in space. I ask them to draw freehand and large enough so that the marks they make are somewhat sweeping. I teach in this way so as to engage their entire arms, not just their finger-tips, whether they are developing an oblique spatial grid in which to project a complex object like a circular saw (see Figure 20 left and middle) or the convergent flow of spatial axes in a one-point perspective of a space (see Figure 20 right).

There is a reason I start with circular saws and find them so useful in building abilities in spatial projection and visualization. As objects—with their blades, guide planes, and motor housings—they clearly embody all three spatial axes. Thus, when my students locate points in space within a spatial armature—and they have to do this with care (see Figure 20 left)—I ask them to actively think of moving the points of their pencils along the X-Y-Z coordinate grids they have already drawn. I think of it a graphic game of three-dimensional hop-scotch, one with all the deep muscle memory such games ingrain, as in: five steps forward, two over, three up etc.

There is a common thread here, one that goes back to one of embodied cognition's core

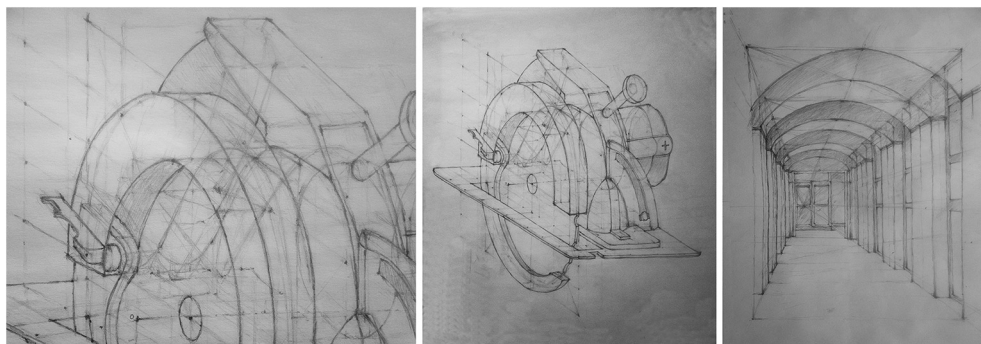


Figure 20 X-Y-Z coordinate drawings, (left and middle) oblique axonometric of a circular saw, Eric Li, (right) perspective view, Steven Fei

understandings. As described by Margaret Wilson, when thinking about spatial subjects, the activity of the mind is grounded in the body's movement in space and prior interaction with the environment (2002: 626). We have found evidence of this in hand gestures used when speaking; in Bilda, Gero, and Purcell's blind-folded architects gesturing profusely when called upon to design without using drawings; and in Murcutt, Moore, and Kahn's drawing loose lines to occupy and move through their developmental plans and sections. We see it in my daughter Sarah's drawing rollercoaster rides in maple syrup so she can imagine and talk about them and in the recent example: students in a chemistry class constructing models of molecules and feeling they are within the spaces these models occupy. All of these examples point to the central argument I am making with this paper. For designers to think spatially about their designs, they must feel and have access to a physical connection with what they are imagining. Further, this connection will come from their hands and bodies acting *together* with their eyes—touch and movement in combination with vision. It will be hindered if it arises in vision alone: limited to dealing with appearance and lacking in substance.

When in his lecture Thom Mayne pronounced the death of drawing, he may well have been right for one kind of drawing: drawing that lacks any measure of the kind of gestural impulse evident in his own drawing. But drawing that lacks fluidity and a three-dimensional core was exactly what Nicolaidis had argued against back in the 1920s and 30s well before computers were ever used for drawing.

Obviously, digital media are here to stay. In writing this paper, I am not questioning using them in practice. They are invaluable for their speed and accuracy for managing extensive building information, whether assuring that changes in one drawing are registered automatically in

another or helping with the three-dimensional visualization of overall massing or corner details. And students, professionals, and clients alike benefit from the heightened capacity to walk through the interiors of proposals at early points in the design process.

The argument here is not directed against digital drawing per se, only at the physically disconnected character of the current digital work place and simply for the reason that, to this point, digital hardware and software do not yet sufficiently engage the whole of the body. There are signs of this being remedied: with larger tablet sizes with varied resistances and more options for ambiguity in graphic display.

So down the road, drawing on paper may in the end pass away as a medium for design thinking. But only so long as, in the interim, digital media develop in ways that are able to engage the three-dimensional thinking embodied in the gesturing hand, a hand that should not be constrained to just the tiny movements of a mouse on a keypad. And so, let us therefore resolve that until that time comes, there are good reasons to retain in-depth and vigorous freehand drawing early in the standard curriculum.

Acknowledgements

Omer Akin, my good friend and colleague at Carnegie Mellon University, read the earliest drafts of this paper when I was operating with hunches and was in need of sound advice about where to go with its theme. An early conversation with Roberta Klatzky of CMU's Psychology Department gave me confidence that despite the limitations of my background—I'm a drawing teacher—my insights from that field could be useful for people in cognition. She and Barbara Tversky and subsequently Andrea Kantrowitz looked at later drafts and gave much helpful advice. My former student Margaret Tarampi (now with the Department of Psychology at the University of Hartford) was a huge help in recommending

papers she thought would be relevant for the issues I was researching. The head of my school, Steve Lee, had suggested I contact her. Friends and colleagues Jeremy Ficca, Rob Woodbury, and Daniel Cardoso Llach also looked at early versions. In addition, Daniel alerted me to the research of anthropologist Natascha Myers into the three-dimensional thinking involved in protein crystallography. Early on, I also spoke with practitioners, Ken Kuligowski and Paul Ostergaard, to gain their understanding of the role of hand drawing in design process. To my wife Stefani Danes, who is a practicing architect, extraordinary design teacher, and outstanding fabric artist, I owe the greatest debt. She encouraged me to take on the question of hand drawing's relevance for design in the first place and read multiple versions of the paper along the way.

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