

The Backtalk of Self-Generated Sketches

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Introduction

Drawing and sketching are activities all humans engage in, at some level or another, as of a very young age (if not deprived of the sense of sight). In developed societies, toddlers use drawing implements to make marks on paper. In less-developed societies, children and adults use sticks to draw on sand. Why do children draw? It seems that for a child, drawing is a form of play, with developmental benefits similar to those of both symbolic play and construction games (play typology instituted by Piaget and Inhelder¹). Most people acquire enough drawing skills during childhood to make graphic production an accessible strategy whenever pictorial representation is more effective than linguistic representation in communication and reasoning. For some communication and reasoning tasks, however, ordinary drawing skills are not sufficient, just as linguistic skills acquired during childhood are not necessarily adequate for sophisticated verbal and written expression tasks. A better command of language makes for better orators and reporters, and a better command of drawing skills makes for better illustrators and decorators. A special class of representational skill, linguistic or graphic, is the one needed for inventive purposes: this is the case of the poet, the visual artist, and the designer. The inventive process does not require wider skills: not necessarily a larger vocabulary or unlimited graphic techniques. Rather, what is required is an ability to use the representational act to reason with on the fly. Usually, this is a “front edge” process in which partial and rudimentary representations are produced, evaluated, transformed, modified, refined, and replaced by others if need be, until their maker is satisfied with the results. The unique thing about such processes is that, since they involve ill-structured problem-solving, it is not clear at the outset where the process is leading to, and what the end result might be.

In this paper, it is our purpose to look at the way in which sketching assists in generating ideas and strengthening them by interpreting the “backtalk” of a sketch in progress,² or one that has just been completed. We use a developmental axis to illustrate our claims. We start with children and show how they “read” new information off their sketches or drawings, and use it to define or refine the rationale for their repre-

¹ Inhelder, P. *The Psychology of the Child* (New York: Basic Books, 1969)

² D. A. Schön, *The Reflective Practitioner* (New York: Basic Books, 1983)

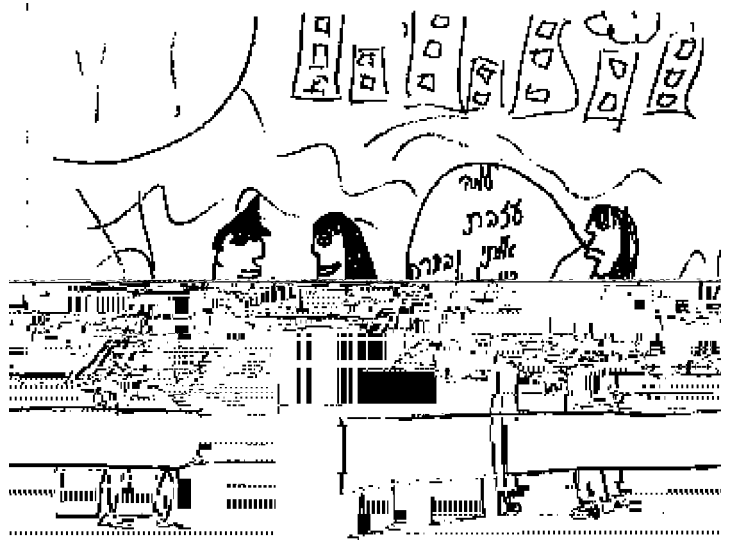
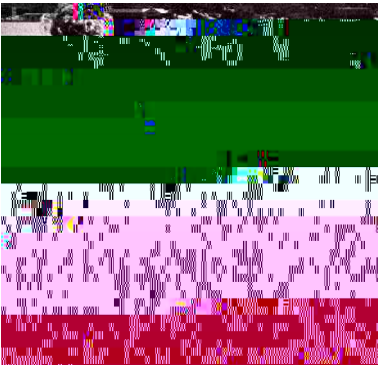
First Scribbles

Children under the age of three years produce scribbles to which they are able to attribute after-the-fact representational meaning.³ In fact, they do not attach meaning to a whole drawing, or scribble, but to parts of it that comprise angular curves.⁴ Researchers found that two graphic schemas are involved in the making of these early scribbles: smooth-inertial and angular-intentional curves. The latter require a slower production speed and a change in direction, and result in breaking points and more closed shapes, which are believed to be richer, that is, to convey more information than smooth lines. Young children who were asked to interpret line sections in drawings, attributed representational meaning to angular curves, whereas smooth lines were referred to in nonrepresentational terms (such as "line" or "circle"). However, the representational significance was suggested only when a child referred to a drawing he or she had just

follows, we show that these characteristics of graphic production are especially robust. They are maintained through adulthood, and are exploited by expert sketchers in the process of designing. To fully appreciate the way in which sketching actually engenders meaning, we describe and analyze in detail one vignette from an older child's drawing activity.

Invention in Drawing

Naomi is nine years and seven months old. When she was younger (four to five years old), she liked to use building blocks to build "models," which also included improvised components such as small toys and various found objects. In these creations, she represented familiar buildings or sites (e.g., her home town), often with additional features that she must have desired to see added such as, in one instance, a swimming pool.⁶ Protocols of conversations with Naomi indicate that the additional, invented features were clearly intentional, although their inclusion in the construction may not have been premeditated.⁷ This pattern, observed in three-dimensional representation, appears to be preserved in later two-dimensional representation as well. Let Us Examine This (Kaplan, 1981) Naomi



Naomi now proceeds to make a drawing “about the things she [W2] imagines”: her being with the man, while the previous girlfriend [W1], now rejected, looks on with envy. She starts by drawing a long bench, then she draws a couple—a man and a woman [M and W2] who stretch their arms towards one another. After the details are rendered (clothing, the man’s beard), she adds another woman [W1], with a cartoon-style bubble that elucidates her thoughts (“Why did you leave me and choose her?” in Hebrew). Naomi completes her drawing with a water body, buildings on the other bank (she confirms the scene takes place in the site shown in the source photograph), and she adds a large sun (upper left corner) and a cloud (above buildings). The drawing is reproduced in Figure 2.

Source and Target Representations

We would now like to compare the two representations—the source photograph and

Of particular interest are instances in which Naomi used a convention, but one that is at odds with the photographic depiction. We would like to dwell on two examples: the buildings in the drawing, and the way in which hair is represented. The buildings Naomi draws are rather prominent—much more so than the ones in the photograph, which are barely hinted at. The buildings must have held a special meaning for her, as she starts her description of the photograph with them, before any mention of the “actors” in the scene. In the drawing, however, the buildings are added at the end. While drawing the buildings she says:

“And then there are these towns one saw in the back. These buildings... Everything was lots of tall buildings. It’s this kind of town, of the past.”

The experimenter asked what a “town of the past” was, and Naomi replied that they have “lots of tall towers.” The experimenter, who sought to reach a better understanding of the appearance of tall buildings in the scene, asked about them again in the debriefing after the session. Naomi explained: “That’s how I wanted it... I saw [in the photo] the tall towns...quite high. Like from far away.” She seemed to not comprehend what it is that the experimenter could have possibly failed to understand. Since she could not have inferred her vision of “tall towns” from the photograph, the experimenter speculated that she could have been under the influence of a previous “drawing game” played a few hours earlier, in which the source was a painting by Hieronymus Bosch that features towers. She asked: “Do you think it could have something to do with the former picture, about which you said it was like many years ago?” Naomi answered: “No, there is no connection.” Influence of the Bosch painting would have explained Naomi’s image of an old town with tall buildings. If this is incorrect, as Naomi insisted, we have no information

“In the photo—no, one has curly hair [W2] and the other has her hair gathered, sort of [W1]....But [in my imagination] she [W2] sees herself prettier than her [W1].”

She went on to explain that “...she [W2] sees the other [W1] like with long hair, and not very much hair.” The experimenter asks whether a lot of hair is prettier, and Naomi confirms: “Yes, like in her [W2] opinion.”

This exchange points to two conventions that Naomi apparently maintained: first, that long hair signifies a female figure in a pictorial representation; and second, that the longer the hair and th

“Because she loves him. And she is pregnant. As if she were his wife.... And the other one loves him too, that’s why she [too] has a dress with a heart. The other one, too.”

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The added meanings enrich

profile mode. This was a better choice in this case because it made it

matches our definition of study sketching, which is practiced by individuals who attempt to conceive of a new entity, be it a work of art, a building, a technically-oriented invention or novel artifact, or a scientific concept. The description and specification of the new entity that is being brought into being in those instances entails shapes and forms. The sketcher represents candidate shapes and forms, their parts and features, and relationships among them. Freehand sketching is rapid and direct, and therefore cognitively economical, and provides instant feedback: the sketcher can enter into conversation with his or her materials.¹³ Because a search process takes place, the sketcher normally is highly sensitized to possible clues, including unintended configurations that result from his or her sketching activity, and which can potentially trigger development. Naomi's pregnant woman, as a result of a dress that has been drawn a little too wide, is a cogent example. We must also add that, since the problem the sketcher is trying to solve often is rather complex, the search comprises multiple steps, and normally numerous representations are produced, sometimes in long series of sketches.

How useful sketching is in search processes of this kind depends to a large extent on the designer's skill. Sketching skill comprises two independent components. The first is fluency: it is required for the sketcher to be able to use sketching without having to spare attention to the actual production processes. In that sense, exercising sketching skills resembles exercising any other skill. The second component of the skill applies only to designers of three-dimensional artifacts: a good command of the system of orthogonal projections. Orthogonal projections, another renaissance innovation, enable the precise and complete description and specification of any object on the basis of simple mathematical rules. It is the foundation of technical drafting that is used in engineering, architecture, and other design disciplines to describe and later to manufacture artifacts or construct closures for space. Among others, it enables the representation of aspects of artifacts and spaces that are otherwise impossible or very difficult to visualize. In Evan's words: "Few things have had greater historical significance for architecture than the introduction of consistent, coherent parallel [orthogonal] projection into architectural drawing..."¹⁴ A skilled sketcher (in the context of design) is one who is trained in the use of orthogonal projections, and whose fluency of production extends to include the representation of configurations using this system. Without it, the sketcher's studies are confined to "the exterior"

Papert's Dilemma

The expert sketcher therefore is someone who can make and manipulate representations fast and with great ease while choosing the most appropriate projection(s). If he or she is a designer, this skill is indispensable in the search that is part of, indeed the most significant part of, the design process. The following vignette will illustrate this point. Seymour Papert (prominent MIT Media Laboratory professor emeritus) is an amateur cook who, according to his own testimony, spends considerable time in his kitchen and values its spatial and visual qualities.¹⁵ He described a problem he did not know how to solve: he lives in a small apartment in which the kitchen was an internal space, not adjacent to an exterior wall and, therefore, without a window. A hallway with a window along its side separated the kitchen from the exterior wall, so Papert cut a large opening into the partition between the hall and the kitchen, hoping to command an outdoors view across the hallway while working in the kitchen. The result was disappointing, because the vista he gained was more limited than he expected. In explaining this to a designer, he used a simple plan of the kitchen and hallway that he was able to draw quite confidently. He was very surprised when the designer suggested that they needed a different representation, and proceeded to sketch an approximate section on the basis of Papert's plan and description. On the section it was easy to point out which dimensions controlled the view Papert possibly could obtain (height of kitchen counter, windowsill, etc.). For the designer, this was a very simple problem and recourse to a sectional drawing was an obvious move. To Papert, a most original and creative thinker in other fields, and not a stranger to a drawing implement, it had not occurred that studying his problem required a representation other than a plan.

The Primacy of Sketching

Imagery has been acclaimed as the most useful cognitive faculty in tasks that require the solving of novel, design, and invention-like problems.¹⁶ Some researchers have claimed that imagery is, in fact, so powerful that paper-based sketching is redundant in designing.¹⁷ We propose that this is not the case, at least not when problems are complex, and we will present empirical evidence to this effect.

Imagery and Sketching

Goldschmidt¹⁸ has proposed that, in the context of design, sketching serves as an extension of imagery; she refers to it as "interactive imagery." Other researchers of design advance similar claims.¹⁹ This characterization implies a circular feedback loop between two kinds of pictorial representation: internal representation in imagery, and external representation on paper or some other sketching surface. In this view, mental images inform the making of a sketch, but the sketch-in-the-making includes "autonomous" properties that result

15 Personal communication, 1988

16 E.g., G. Kaufmann *Imagery, Language and Cognition* (Bergen: Universitetsforlaget 1980)

17 U. A. Athavanker, "Mental Imagery as a Design Tool" in R. Trappl, ed., *Cybernetics and Systems Research 196: Proceedings of the Eleventh EMCSR Vienna Austrian Society for Cybernetics*, 1996, 382-7

18 G. Goldschmidt, "The Dialectic of Sketching," *Creativity Research Journal* 4:2 (1991):123-43

19 For example, J. Fish and S. A. Scrivener "Amplifying the Mind's Eye: Sketching and Visual Cognition," *Leonardo* 23 (1990):117-126; T. A. Purcell and J. S. Gero, "Drawing and the Design Process," *Design Studies* 9:4 (1998):389-430; M. Suwa and B. Tversky, "What Do Architects and Students Perceive in Their Design Sketches? A Protocol Analysis," *Design Studies* 18:4 (1997):385-403

from emerging relationships among its elements (i.e., lines, dots, etc.), some of which may be unintended. These properties are interpreted in ways that are meaningful (ng

positioning of elements adjacent to others (horizontal y, vertical y, or diagonally), or inside of others. The latter

fast enough leads to frustration and discontent. Therefore, we return to the hypothesis that sketching is useful in the generation of design ideas. What added value does sketching offer, as opposed to the scrutiny of other displays?

Two premises underlie our reply to this question. The first is simple and straightforward: we propose that sketches, too, serve as displays. We refer to them as self-generated displays. The second premise is a hypothesis: we propose that consulting self-generated displays is, for the most part, cognitively more economical than seeking useful

transformational acts she may choose to exercise and experiment with (e.g., shifting, rotating, and flipping over a layer in relation to

have a dialogue with it, and the sketch's backtalk is the reward they get for bringing it into being.

Conclusions

The special role of sketches in design processes is distinguishable from the role of other images and visual displays that are used to support the design process. Designers make sketches because the sketch is an extension of mental imagery, and therefore has the freedom of imagery to retrieve previously stored images and to manipulate them rapidly. At the same time, because it leaves a hard trace of these images on a visible surface, and because this is an additive process, the sketching surface soace,

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