

Basic concepts for tool use in HabilisDraw

Robert St. Amant

December 6, 2001

For the past few weeks I've been thinking about this "theoretical foundation" that we would slide under the HabilisDraw implementation. I haven't come very far, but consider the following. One perspective on tools and tool use that we have partially explored puts tools in four categories:

- Tools that produce a persistent effect on materials or the environment, which we will call *effective* tools. This might seem to encompass *all* tools, but we have a restricted notion in mind, which should become clear in the context of the other categories. Examples in the physical world include hammers, saws, etc. In HabilisDraw the only effective tool is the pen.
- Tools that provide information. These have been called *instruments* in the tool use literature [Hutchins, 1995]. Instrumentation may be built into an effective tool, as when a table saw indicates the angle at which it is cutting a board. Physical instruments that act alone include measuring tapes, calipers, microscopes, and so forth. In HabilisDraw the magnifying glass is an instrument; when tools such as the ruler and compass include visible measurements through which the user can track progress, these will incorporate instrumentation as well.
- Tools that constrain or stabilize materials or the environment for the further application of effective tools. We'll call these *constraining* tools. Examples in the physical world include clamps and rulers; notice that they do not include screws and nails, which are commonly thought as materials, in that they are intended for single use and remain in the finished product. In the physical world, we often find artifacts that are simultaneously constraining and effective tools. For example, a standard saw blade is effective, in that it makes a cut in a piece of wood, but it is also constraining, in that the breadth of the blade forces (or at least facilitates) a straight-line cut. That is, because the breadth of the blade must follow the effective edge through the groove as it is cut, it is easier to cut in a straight line than not. We notice that jigsaws and keyhole saws have a very narrow blade just to relax this constraint. In HabilisDraw the ruler and compass are examples of constraining tools.
- Tools that demarcate the environment or materials. The goal of demarcation is to distinguish similar areas or pieces of the environment so that they can be treated differently. In the physical world this means the carpenter's pencil; in HabilisDraw we find pushpins and guidelines.

We can consider this a taxonomy of tools. Is it complete? I don't know. It seems to cover all the physical tools that I can think of, while excluding various artifacts that I don't think of as tools. I think it would be possible to describe all of the different artifacts implemented in HabilisDraw in these terms. If not, then we'd need to extend this taxonomy.

Here's what I'd like for us to do:

- Expand on this taxonomy. For example, it seems reasonable to identify specific, defining properties of effective tools that are associated with their use. We might say that some of the defining properties of a

ruler are its position, orientation, and length; of a compass its position, radius, and angle of the moving leg. We might then relate these specific properties to the values that are displayed by an instrument associated with the effective tool. Other relationships to demarcating and constraining tools might be made as well.

- Given a more detailed taxonomy, it would be nice to be able to describe in abstract, theoretical terms the nature of all of the tools that are used in HabilisDraw. Can we describe the function of a ruler in abstract terms? This seems reasonable. How can we tie its description to those of other tools? Here we're not so much concerned with a static description of the structure of the tools but rather their functionality and dynamic interactions.
- What can we say about the way that constraining tools work? I've been thinking about tools lately as devices that transform actions. For example, think of the path that a pencil might take moving unhindered over a piece of paper; now think about its movement against a ruler. We've taken an arbitrary movement, which we might represent as a curve in 2D space, and transformed by applying a linear limit (i.e., when the pencil bumps up against the ruler, its former motion is mapped to a point on the straight edge.) We might apply the same reasoning to the way a compass transforms a movement into an arc of a circle. Can all constraining tools be viewed in this way, as performing transformations on their input? It seems to be the case for many physical tools.

Please think about these points, and see if you can either support them, expand on them, or contradict them. What I'd like to end up with, eventually, is a formal way of describing and reasoning about tools in HabilisDraw, in a way that might extend to reasoning about physical tools.

References

Hutchins, Edwin 1995. *Cognition in the Wild*. MIT Press, Cambridge, MA.