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## The Digital Apprentice

Imagine making fresh pasta in your kitchen. The ingredients get placed on the counter, one by one. Pour a cup of flour onto a board. Knead in the eggs, salt, and water. Roll out the dough; monitor its thickness. Cut, stuff, pinch, and boil.

Now imagine what this might be like if your work were overseen and guided by a master chef. A seemingly sequential process—measure, pour, and mix—is broken up into more bite-size steps. To accommodate the foreign rhythms of other hands, your kneading slows down and your forearms loosen. Sensing another pair of eyes, you notice the texture of the dough, the crispness of the shape. Embedded in a larger system of learning, you pick up the skill set from multiple angles and dimensions. Once practiced over months or years in a kitchen, your basic hand gestures turn *know-that* into *know-how*.

What does it mean for a tacit skill—cutting, folding, drawing—to move from one person to another without face-to-face human interaction? How do embodied competences get produced, policed, or shared? Can traditional forms of apprenticeship be reproduced using digital tools?

For some time I've been intrigued by the work of University of Bologna researchers in developing systems for what they term "preserving artisanal knowledge." Their tortellini-making computer game invites a novice chef to hone his or her pasta-making skills by watching videos of an expert [1]. As

the player attempts to replicate the expert's workmanship, the system tracks and evaluates the player's actions and adjusts the video accordingly. The video plays the next step in the tortellini-making process only if the prior step was completed sufficiently well (according to the system's computer-vision algorithm). The tool thus combines video with gesture recognition to simulate in-person instruction. In another system designed for shoe repair, the vision system traces the sequence, number, and speed of actions performed while sewing and hammering leather.

Here, bodies are turned into data, and data is materialized through technique. An algorithm "sees" and recognizes the tortellini, analyzing the hand gesture in relation to a pre-specified set of attributes (speed, sequence, orientation of the hand). Satisfying the system and moving onto a subsequent step entails particular ways of thinking, learning, and knowing. The algorithm does not account for where the flour came from or how it was milled; it does not care whether the tortellini originated through a colonial heist or how it might be (re)imagined by different makers. Making sense of the pasta's heritage seems just out of reach.

Apprenticeship is an old story. We know that everything from letter cutting to glass blowing has been passed down through acts of physical manipulation deeply informed by people, stories, and practices. Yet, as we shift from

these complex forms of learning to image processing and video, what is gained and what is lost? Modern forms of apprenticeship introduce multifaceted opportunities for learning while overlooking some of the thorny tactics, politics, and histories in which the craft is embedded. There are limitations to our tools for crafting, just as there are limitations to our tools for passing on our know-how. The introduction of online tutorials and videos has not only enabled us to learn new skills; it has also shifted our ways of learning and discovering—particularly for practices we didn't even know existed.

A case in point is my recent booth at Maker Faire, an annual festival celebrating diverse do-it-yourself (DIY) practices of reuse, customization, and craft. I was demonstrating a particular knotted-lace technique called *tatting* to create soft circuitry when a young woman approached my table.

"This is the first time I've seen tatting *not on the Internet*," she said. I had to pause for a moment. This young woman had only seen tatting—a Victorian lace-making technique—online? She nodded; she had discovered and learned the technique by watching YouTube videos. "I like historical stuff," she said.

I asked her to show me how she tat and handed her the supplies: a tatting shuttle and thread. I watched as she shuffled the bobbin back and forth through a tight thread held in her left fingers. Sure



enough, her technique was largely the same as my own. I learned from an expert in my knitting guild; she learned from a video.

The YouTube video and the tortellini game have something important in common. They both enable more or less the same set of practical outcomes by encoding aspects of the process in digital imagery (creating an even texture or a crisp edge). Yet they also leave out some of the story: how Victorian tatting was meant for aristocratic women to show off their delicate hands; how lace makers made up aspects of their technique as they went along. Gleaning information from video, we seem to gain accessibility but lose something else: the community of practice.

Jean Lave and Etienne Wenger discuss the community of practice as the set of complex social relations (among makers, activities, and the world) through which learning takes place [2]. Rather than participating in a didactic exchange with their master, apprentices are indebted to the relationships at the very core of their practice. Our ways of knowing are conditioned not only by the tools but also by the practices of those who use them.

For the person learning a new technique on YouTube or through a novel game, where is the community of practice? It could be located among the suggested clips following the first video—the mechanism through which this lone tatter discovered tatting. It could be located in the chat rooms, mailing lists, and social networking sites dedicated to craft. Or it could not exist at all.

Distance from the source is not a new challenge for those desiring tacit knowledge. How-to books and encyclopedias have long described ways of working with one's body or hands from afar. But inherent

in the process is a loss of proprietary knowledge. A bookbinder once told me that he came across a curious definition in an 18th-century dictionary of the arts and sciences. If you tried to follow the instructions for gold tooling, you wouldn't get far. The information was inaccurate, and deliberately so. The man who wrote the book had produced his account by questioning other people about what they knew, including a binder who—not wanting to show anybody else his skills—provided misleading information. Secrecy enabled him to protect his livelihood. In the same way, although digital practice gives the illusion of open access, key aspects of the process are still withheld.

As we move from human practice to image processing, researchers may benefit from casting a careful eye toward digital apprentices and how technologies condition their means of apprenticeship and work. Such an analysis can help us locate the processes that matter (e.g., secrecy, curiosity, and care) in the communities in which they are embedded. It can lead us to focus on the visual details of craft as well as the rich sensory engagements from which they arise. A robust vision of apprenticeship online would involve the subtle integration of these additional facets of practice to enhance the process. This vision can ultimately enrich what and how we know in a digital world.

#### ENDNOTES:

1. Roccetti, M., Marfia, G., and Zanichelli, M. The art and craft of making the Tortellino: Playing with a digital gesture recognizer for preparing pasta culinary recipes. *Computers in Entertainment* 8, 4 (2010), 28.

2. Lave, J. and Wenger, E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge Univ. Press, 1991.