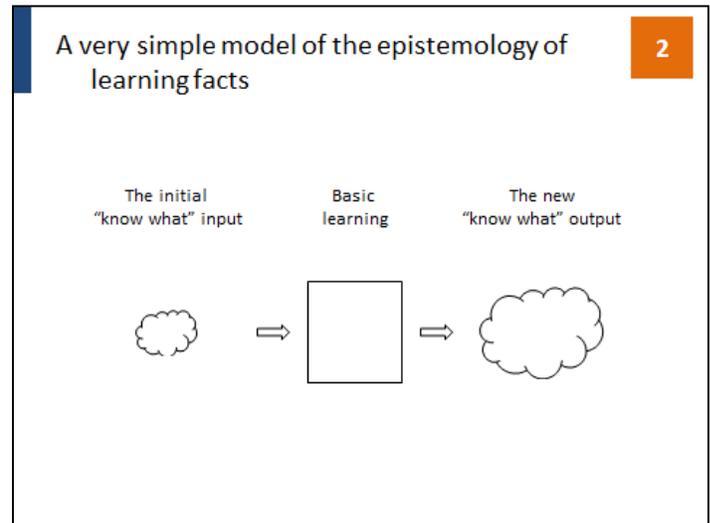
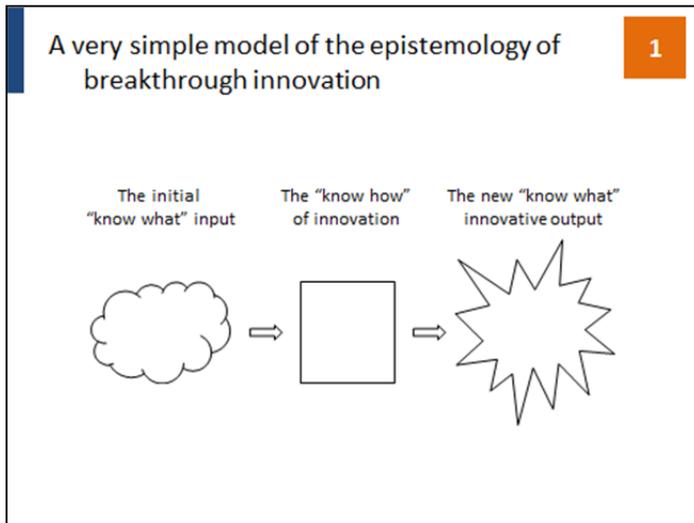


A simple qualitative, yet mathematical model powerfully illustrates how breakthrough innovators come to know

Flatland: A simple model of learning facts

Breakthrough innovators are well-described as curious, learning, multi-dimensional individuals



With the past two essays we have been on a journey, one that eventually will propel us into new dimensions of insight on the epistemology of breakthrough innovation.

Beginning with the simple framework depicted above in Figure 1, I noted that a breakthrough innovator's "know what" base of factual information serves as the input to their "know how" of innovation skill, with the result being the emergence of innovative insight, a new "know what" output. I next began to dissect this model, exploring and developing the "know what" aspects of this model, the initial "know what" input to innovation and the new "know what" innovative output.

In the essay after this present one, we will consider the "know how" of breakthrough innovation in detail. Only after laying such groundwork can we bring these elements together in order to see how they work as one, illustrating how breakthrough innovators come to know what to do today in order to succeed in the future.

However, before moving on, I thought it best to first further develop our understanding of the "know what" aspects of the model by looking at how we might model "learning facts" (and, in reverse, forgetting them!).

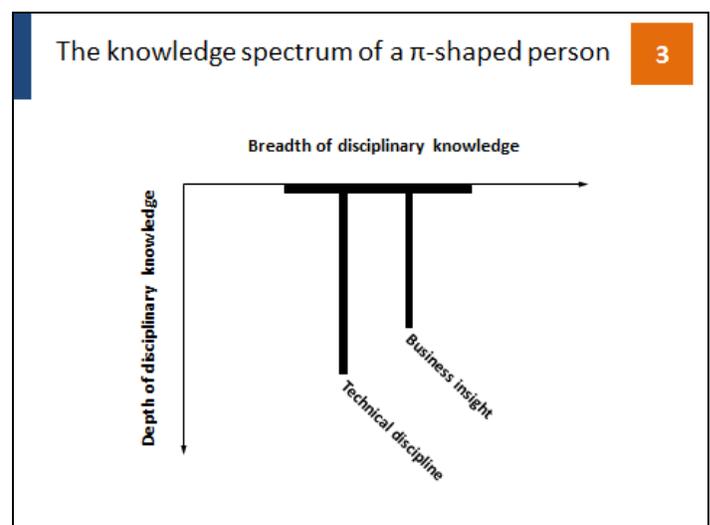
What do I mean by "learning facts"?

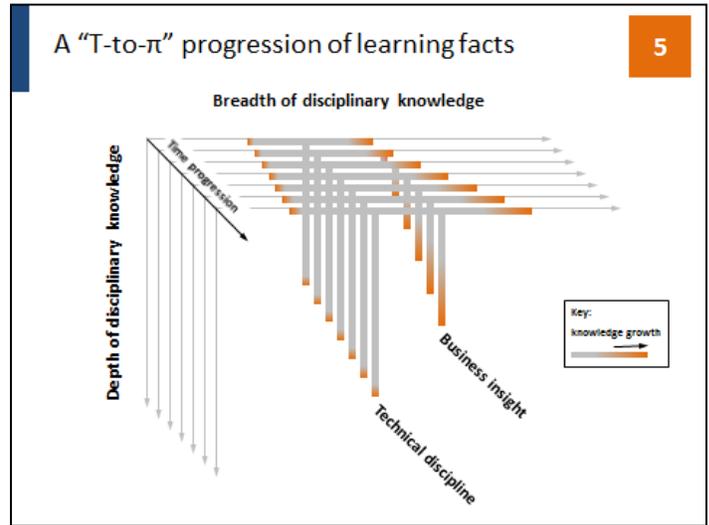
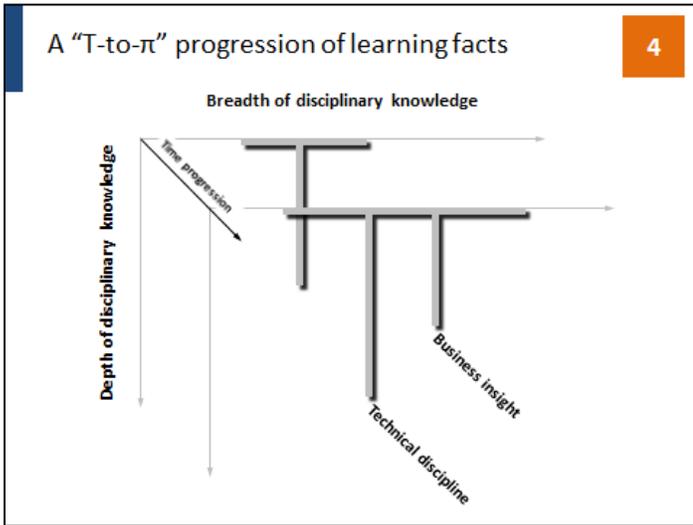
By "learning facts" I simply mean acquiring and retaining facts, an increase in what is known as propositional knowledge, as discussed in Essay 12 (*What it means 'to know'*). I also spoke of this in some detail in Essay 8 (*The Magic Eyes® of innovation: The role of memory*) using the Mr. Memory character of Alfred Hitchcock's film, "The 39 Steps", to illustrate the memorization of facts in the extreme. Actress Marilu Henner, known for her Elaine Nardo

character in the sitcom "Taxi", represents a real example of an individual possessing a truly superior memory.¹ One of only a few dozen known cases of hyperthymesia, Henner has the capacity to recall – from memory – a remarkable level of detail about each day of her life.

What I do not include in this definition is any "sense making" relative to these facts. No insight nor understanding is involved in this definition, just the absorbing of factual information.

Simply put, I begin by suggesting that learning facts can be illustrated with the framework depicted in Figure 2. An individual possesses a certain amount of factual information at first and then merely adds to it. The resulting number of facts stored is larger than it was in the first place. ➤





Expanding our use of the knowledge spectrum

In the last essay (*Flatland: Its π -shaped inhabitants*) I introduced the concept of the knowledge spectrum, depicted in Figure 3. With it I noted that many have recognized that breakthrough innovators bring both depth and breadth in their disciplinary knowledge base. Industrial innovators are often anecdotally described as "T-shaped" in that they know a great deal about their primary discipline (the vertical stem of the "T" represents the depth of their knowledge) and something about many other disciplines (the horizontal bar at the top of the "T" represents the breadth of their knowledge). Further, some have observed that breakthrough innovators are " π -shaped" or even "M-shaped" in that they exhibit significant depth in multiple fields (two for the " π -shaped" or three for the "M-shaped").

Now, let's expand our use of the knowledge spectrum by incorporating some time variation of the spectrum, a time variation where an individual only learns facts. While such limited personal development typically does not occur in an isolated way over extended periods of time – that is, people tend to make sense of what they learn, not just memorize it – let's limit our discussion here to just that, expanding it subsequently by incorporating other features of learning.

So, how might we depict the time variation of the knowledge spectrum of someone who at the outset holds an advanced degree in a technical discipline along with some fairly broad general knowledge and then goes on to secure business insight on the job, peripherally picking up some additional general knowledge and technical insight along the way? This is illustrated graphically in Figure 4 – the person

morphs from being "T-shaped" to " π -shaped". Additional detail of this gradual transition over time is presented in Figure 5, with the larger orange-shaded portions of the knowledge spectrum illustrating the portions growing most rapidly.

How might we tie this discussion out with what we've observed about breakthrough innovators? Well, they are curious and have a great capacity for absorbing, retaining and recalling factual information. Looks a lot like the "T" to " π " transition depicted here, doesn't it? ■

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ⁱ Henner is profiled in Carrie Golius' "Permanent Record" appearing in the Summer 2013 issue of The Core, the College Magazine of the University of Chicago (<http://thecore.uchicago.edu/Summer2013/features/permanent-record.shtml>).

"On the Epistemology of Innovation: How Breakthrough Innovators Connect the Dots" is a series of brief, occasional essays addressed to executives, managers, and technologists responsible for innovation in industry. Its purpose is to challenge readers to reflect broadly and deeply on the practice of innovation – in particular on how innovators come to know what to do today – in order to succeed commercially in the future. Essays are available without charge at the University of Illinois' digital archive at <https://www.ideals.illinois.edu/handle/2142/27667>. The discussion group at <http://epistemology-of-innovation.com> is a place to provide feedback and dialog with the author and others regarding these essays, as well as to register to receive notice of new essays as they are issued.