Learning how to learn mental MODELS

A practical philosophy with basic principles

for learning, creating and dealing with problems

Learn how to:

- Build mental models from dual views
- Act effectively without thinking
- Solve problems intuitively
- Use limits creatively

Neil Keleher

Learning how to learn: mental models

A practical philosophy with basic principles for learning, doing and dealing with problems

Neil Keleher

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Overview Contents

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Mental Models

Mental models are the result of anything that we learn.

The term *mental models* as used throughout this book refers to the actual *programs* or *program equivalents* that the brain creates in response to episodes of learning.

Basically, anytime we learn, our brain creates a mental model (or mental models) to represent that learning. These mental models each have outputs, inputs, intelligence for processing inputs and for recognizing triggers that signal a particular model (or models) when it is appropriate to act. They also communicate with each other.

Based on the work of Vernon Mountcastle, cortical columns located in the neocortex could provide the the basic hardware modules for housing individual mental models. Jeff Hawkins and the Thousand Brains Project builds on this and suggests that these same modules also contain grid cells and the ability to model location and displacement of things outside of ourselves.

Habits and Intuitions

A big assumption throughout this book is that the main outputs of mental models are habits.

Habits are things that we do without thinking. Habits are the outputs of mental models and so any habit has behind it a mental model. Habits can be physical outputs but they can also be thoughts or patterns of thoughts, for example, something we think in response to something we experience.

Other outputs of mental models include intuitions. These can be regular outputs, like the names of friend, the answer to a simple math equation etc. But they can also be irregular outputs that result at some point in time as a response to some clearly framed question or problem.

Habits offer us another way to think about or conceptualize mental models. Instead of or as well as thinking of learning in terms of the mental models that result, we can think of learning in terms of developing habits. This is exactly the same as the idea of developing muscle memory. Except we normally don't tend to associate muscle memory with the idea of intuition or of maps of things we've learned that we can visit and tour in out head.

In most cases, habits and mental models can be thought of as one and the same thing or as aspects of the same thing. If we can use a particular mental model or set of mental models without thinking, i.e. via habit, then we've learned.

Fast feedback

One aspect of learning efficiently is getting fast feedback. If we are teaching ourselves, or learning independently, then depending on what we are learning feedback may just be a signal that something is wrong. So after getting the signal that things aren't going the way that they should, the next stage is figuring out what is wrong (or what we are doing wrong.) The things we can notice could be thought of as details.

- Details can be things like the placement of commas, semi-colons and brackets when programming.
- It can be noticing whether we are supposed to be using http or https when setting up a web host.
- It can be things like changes in output speed when we make a change to a script we've written (for example, using python).
- Or it can be noticing how slow something runs and asking ourselves if there is a way to speed things up.

In a lot of instances, the ability to notice comes into play when we run into problems with what we are learning or doing. The better we notice details and their significance, the easier it is to solve problems.

Noticing how things relate

Another big part of learning is noticing how things relate. When we notice how things relate we can replicate that relationship or where necessary, change or vary it.

- Doing something like (Chinese) calligraphy, it can be noticing how two particular strokes relate to each other positionally when learning a particular character.
- Playing frisbee it can be noticing the orientation of our body relative to who we are throwing to.
- Playing a racket sport it can be noticing our position relative to where the ball bounces when trying to make a return shot.
- Practicing shooting hoops it can be noticing where the ball bounces on the backboard relative to some part of the square that is painted just above the net.

Noticing in general is easier when we have the ability to break down what we are learning, or practicing, and group or isolate aspects of what we are learning. Alternatively, noticing is easier if we simply focus our attention.

Mind-states

In general, whether learning or doing, a key to noticing is our mind-state. For the purposes of learning how to learn, we have two main mind-states.

One is the thinking mind-state. Thinking generally takes time and one of the reasons for building mental models is so that we can act without thinking, without the time lag that thinking tends to incur.
The other is the fluid mind-state (aka: the flow state or no-mind). With the fluid mind-state we aren't thinking but we are also, ideally, focused on what is happening now. That means engaged with our senses so that we, if focusing and directing our senses appropriately, notice change as it happens.

- Thinking is a mind-state that we can use to clearly define, break things down, define groups, assign to groups.
- The fluid mind-state is where we aren't thinking, instead we can be focusing on using our senses and responding.

(There is an alternative mind-state, what I'll label the day-dreaming mind-state, where we also aren't thinking. This mind-state makes it easier to access intuitions from mental models.)

A big part of learning how to learn is getting into the fluid mind-state as much as possible while practicing. That said, another big part of learning is using the thinking mind-state to divide, differentiate or break down what we are learning so that it's possible to get into the fluid mind-state while practicing.

In terms of mind-states, one goal of learning (of building mental models and attendant habits) is to enable us to function in the fluid mind-state so that we can sense change and respond to it with zero time lag. The main driver for this is that thinking takes time. Learning, building mental models is like doing the thinking ahead of time.

Short-term memory

One of the biggest limitations when learning is short-term memory. When we recognize its limits, by banging into them, and adjust what we are learning at any one time to work within them, learning can be a lot easier and a lot more fun. That's because we don't have to think while working within those limits. Instead, we get into the fluid mind-state.

If we memorize a sequence of yoga poses, or the movements of a tai ji form, we can focus on doing what we've learned without having to copy someone or work from a book or video. Memorizing the sequence of brush strokes for painting a Chinese character, or from there, memorizing a string of Chinese characters (perhaps a poem), we can focus on painting as opposed to thinking about what stroke or character is next.

To work towards learning whole sequences of poses or movements, or characters, we can break down what we are learning so that we work within our short term memory limits. We can then sum together what we are learning via mid-term memory.

The biggest selling point for working within short term memory limits is that it makes it easy to get into the fluid mind-state while practicing. And that can make practicing (and particularly memorizing) an enjoyable experience.

Depending on what we are learning, in general the easiest way to work within the limits of short-term memory is to break things down.

Breaking things down

If we have something complex to learn we can *break it down* into clearly defined ideas to make learning easier. Depending on the context, we can group these ideas to make memorization easier, or we can isolate ideas so that we can learn them one at a time.

In terms of learning, of building mental models, we could think of breaking something down so that we can take it from outside of ourselves to inside. Inside ourselves, our brain can then reassemble or integrate.

Benefits of breaking things down include making it easier for our brain to index what we are learning, so that it is easier to recall. It also makes it easier to work within the limits of our short-term memory and to notice how the resulting clearly defined ideas relate to each other.

Breaking something down can also result in the increased potential for creativity. If we think of the result of breaking down as clearly defined ideas, then depending on what we are learning and the level at which we break something down, we may be able to recombine the resulting clear ideas in different ways.

Another benefit of breaking things down, is that it can provide one of two necessary points of view of what we are learning. That in turn can provide a framework, a context, for the other point of view.

Two points of view

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Practice

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Stability and room to move

Stability and Room to Move are two principles that we can work with when noticing or doing things, and as a first step for dealing with problems.

The basic context for both of these principles is a relationship. A connection creates a relationship and allows change to be transmitted between those ideas or allows those ideas to create change.

For one idea to affect or change another they have to be connected. For change to occur one idea within the relationship, and only one, acts as the foundation. The other idea then is the expression. From there, they each need room to move for that change to manifest effectively while maintaining the connection.

Prototyping

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Environments, Sensitivity and Change

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Sensible limits

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Sensori-motor learning

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Slow and smooth movements

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Creativity

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More creativity

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Zeroparallax

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Dual mind-states, Dual points of view

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Limits for becoming limitless

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1 Mental models

Our brain is a model builder. It builds models, or *mental models* so we can use them to better experience life. These mental models are built anytime that we learn.

Once built, mental models process information received through their inputs. Based on their built-in intelligence or programming, they output responses. Their responses can be physical reactions, thoughts, or information. They can also be intuitions. Outputs other than intuitions can be thought of as habits.

The outputs of mental models, whether habits or intuitions, generally occur without thinking (or *mental effort*) and with little or no time delay.

Modelling the world so we can interact with it

One reason that our brain builds mental models is so that we can interact with the world around ourselves. To that end it has models for the things we can sense via our eyes and ears. And it has models for the things that we can or may interact with. And in turn, so that it can interact effectively it has models for the elements of our body, particularly those involved in touch, and the sensing, generation and transmission of force.

Our brain uses mental models to model our body and what is around us so that we can act effectively without having to think.

Hearing a ball bounce in a particular way, even though we don't see the ball we know that it is heading our way. A mental model was built (perhaps as a result of being hit by a ball, or simply as a result of playing with balls) and as a result when we hear that bounce we turn to check the trajectory of the approaching ball so that we can take appropriate action.

Seeing traffic cones on the road we know that they are fairly soft and mobile, and that generally they are put somewhere as a warning to stay clear. There's a mental model or set of models that activates whenever we see (or think about) traffic cones. Seeing them on a road we know to drive or walk around them.

Assuming we've had enough practice, we can watch a frisbee or ball thrown to us. Our brain processes the information. It maps the location of the frisbee as it moves and it maps the locations of parts of our body and it moves the necessary parts so that we can catch it without having to think (assuming we have the necessary experience and have learned from the experience).

Models for the things we do

The same infrastructure that supports or holds the above types of mental models also supports mental models that result when we deliberately learn things whether external systems, or systems of movement (or doing things) that directly involve ourselves (including catching frisbees or balls).

To ride a motorcycle, we learn the various models that allow us to control the bike without having to think. As a result, instead of having to think about how to steer, change gears, accelerate or slow down, we can do all of these things in response to the road and what is on it.

Doing high school math, we can do simple math operations without thinking because we've done those simple operations enough times that they've become models and now every time we see 2x8 we know without thinking that the answer is 16. As for more complicated math, we can do that too (or elements of that) without thinking because we've learned and repeated the necessary steps enough times that we have models for all of them.

Practicing Tai Ji if we've learned the movements, we can focus on doing them while maintaining connective tissue connection between the parts of our body so that the movement of one part is effortlessly transmitted to other parts.

Doing yoga poses, if we've learned a pose, and if we've learned our body, we can focus on feeling and controlling our body while moving deeper into the pose because of the models we've developed while learning both (the pose and our body).

Models for the things we use

Another aspect of mental models is that they allow us to visualize systems, particularly if we learned the parts of those systems and how they interact.

Having learned the parts of a computer system, or mechanical system, the mental model of that system allows us to visit the system in our minds eye; in addition, we don’t have to think about how the parts go together and work together, we know.

If there are problems with the actual system, we can use the mental model as a guide to figuring out the source of the problem. And if we don’t have a mental model, if we haven’t yet learned the system then part of problem solving is learning it.

Mental models also provide intuitions based on systems that we’ve learned.

Models for understanding and interacting

I first learned about models in Grade 7 science class. Mr Tollett, our teacher, told us that science is the process of building models of reality. He said that models can never truly represent the thing that they model and so science is the process not just of building models but also improving them.

Why would scientists build a model of something? So that they can use the model to predict how the thing it represents will act; but also to understand the thing in question so that that understanding can then be used to solve problems.

Mental models are models that our brain builds to represent things that we've learned. Some of these models might be thought of as parts of the equivalent a computer operating system. They are the models are brain builds when we are babies and as we grow that allow us to control our body and interact with the people and things around ourselves.

Then there are models that we chose (or that are chosen for us) to learn. These could be thought of as the equivalent of applications (or apps).

- These might be for mundane things like how to wash dishes, make our bed or do the laundry.
- They can also be for subjects like Math, Science, History, Geography, English.
- They might be sports related, whether those sports are team sports or individual athletics.
- They might be for hobbies, past-times or physical activities like yoga, tai-ji or some martial arts.
- And they might be job related, systems that we have to use or interact with or fix.

Making learning less effortful

One of the basic tenets of this book is that mental models, and their associated habits and intuitions, are the result of learning.

The idea of this book is to provide a framework and the necessary understanding for improving the mental models we deliberately build and use, and for improving the process of building them. It's to help reduce learning effort while at the same time improving our ability to use models to successfully handle both the expected and the unexpected.

As well as helping to reduce learning effort, other benefits include clearer thinking, reducing frustration and making learning, through use of the fluid mind-state, a more enjoyable experience.

Human (vs AI) Learning

One of the inspirations for this book is the rise of AI learning. The more AI learns, the more it can do, and the less there is for ourselves to do. That said, the better we understand learning for ourselves, the easier it is for us to learn what we want to and need to learn and the more we can do (or choose to do) and the more we can enjoy our own life.

My own life has been quite varied and throughout it all what I've tried to do is learn a way of doing things to make life easier for myself. So for example, principles I learned while going through basic training and technical training in the army I applied to teaching and doing yoga (and helping other teachers get better at adjusting yoga poses).

Similarly, some ideas I got from some very good professors while at university have had a lasting impact.

I've used these principles and ideas, and others, while raising a child as a single father in a foreign country. I've used these to teach myself things, but also to become a better more adaptable student where I am learning from others.

These same principles have made it easier for me to teach myself how to program. But I've also taught myself how to feel my own body and to use it more effectively in anything that I do.

When I was a kid, my mum frequently reminded me of how clumsy (and loud) I was because I was. I'm still prone to clumsiness and loudness, but I also now have the ability to move and act softly and gently with sensitivity and control, and that too is part of this book is about. And I'm constantly improving, and enjoying the process of improving because I've learned how to learn and because I have an understanding of the mental models and habits that result from learning.

Enabling the power of choice

In a blog post entitled *Tech Independence*, the author Derek Sivers wanted to help readers set up their own cloud based server so that they could be less dependent on tech companies. He suggested a software called OpenBSD because it was designed to be as stable as possible with minimal changes. Where operating systems like Windows and Mac tend to add features (and headaches), OpenBSD is maintained with the idea of reducing features (and headaches).

Derek wrote a script to help readers set up their own OpenBSD server along with their own online *cloud repository* as well as a host for their own website, private email and even a contact list. While the end result isn't complete independence, the result could be thought of as *being as independent as possible*.

This book has a similar goal, to help you, the reader become **as independent as possible** through learning how to learn.

Knowing how to learn gives us more choices both in what we learn and how we learn it, with or without the help of experts or coaches and with or without pre-structured material.

If we learn how to learn, we can choose and define what we learn and how.

Model Hardware

One question that may arise is how does our brain store models? What is or where in the brain is the actual biological hardware for these models? If we are constantly learning and our brain constantly building models of what we learn (to encapsulate and make useable what we learn) where and how does it store these models?

Vernon B. Mountcastle proposed what has come to be known as *cortical columns* as a basic modelling and processing unit within the neocortex of the brain.

> Each module is a local neural circuit that processes information from its input to its output and in that processing imposes transforms determined by the general properties of the entity and its extrinsic connections.
> …
> That module is, I propose, what has come to be called the cortical column.

I'd suggest that perhaps the most important or salient aspect of his work for the purposes of this book is the idea that these units have inputs, some "intelligence" to process those inputs, and outputs. (They also have the ability to communicate with each other.)

Neural modules

Mountcastle goes on to suggest that the same basic building block, the cortical column, is used throughout the neocortex.

> … the processing function of neocortical modules is qualitatively similar in all neocortical regions. Put shortly, there is nothing intrinsically motor about the motor cortex, nor sensory about the sensory cortex. Thus the elucidation of the mode of operation of the local modular circuit anywhere in the neocortex will be of great generalizing significance.

While different areas of the brain might have different external functions, internally, they are built using the same basic building blocks or *neural modules*.

> In summary, **I conclude that cytoarchitectural differences between areas of neocortex reflect differences in their patterns of extrinsic connections**. These patterns are in no way accidental. They are detailed and precise for each area; indeed, they define it. The traditional or usual "functions" of different areas also reflect these differences in extrinsic connections; they provide no evidence whatsoever for differences in intrinsic structure or function. **This suggests that neocortex is everywhere functionally much more uniform than hitherto supposed and that its avalanching enlargement in mammals and particularly in primates has been accomplished by replication of a basic neural module, without the appearance of wholly new neuron types or of qualitatively different modes of intrinsic organization**.

Thousand brains

The work of Mountcastle has been built upon and expanded further by Jeff Hawkins and his *Thousand Brains* concept. An important aspect of Hawkins work is that the above *neocortical modules“ build structured models with reference frames. These reference frames are what allow us to interact physically with the world around us (but also, perhaps, to visit places in our mind’s eye).

> As with sensorimotor learning, reference frames are used throughout all levels of information processing, including the representations of not only environments, but also physical objects and abstract concepts - even the simplest representations in the proposed architecture are represented within a reference frame.

A general approach to learning

You don’t need the above knowledge or understanding to make learning to learn easy. I certainly didn’t. That said, what I’ve tried to do throughout a large part of my life is to find the easy way to do things. That means wherever possible using the same concepts and principles to make learning, leading, teaching, problem solving and in general doing as easy as possible.

The idea that the brain uses the same basic modelling units is a suggestion that this approach, of having a general approach to everything, and in particular for this book, to learn how to learn, is “reasonable” and “sensible”.

From another point of view, a while ago, I came to the conclusion that one of the most important aspects of doing something with intelligence or of building something with intelligence, is having sensors (inputs), outputs (some means of creating change), and varying amounts of intelligence, switching or processing power in between.

While it’s not always important that the same thing is used as both input and output device, a good example of how important having “reusable” or “reconfigurable” inputs and outputs is smart devices, whether tablets or phones, with their touch screens that act as both inputs and outputs.

Actually, I’d say that it is the general nature of the input and output device, and how it can be set up or programmed for different uses that make these devices so popular and so handy.

Now imagine if our brains had a similar feature.

Programming ourselves?

Anyone can write a program or app for a smart device. I've done it. And the range of possible types of apps, as well as apps themselves is quite possibly infinite.

For a smart device to be so flexible and useful all it requires is (configurable) inputs and outputs, and some means of programming it in a way that it processes those inputs and responds via the output.

A large part of the flexibility comes from being able to divide the input/output area into regions so that it can recognize or differentiate inputs and so that it can define and organize sensible outputs.

I'll suggest here that learning how to learn is in part like learning how to use a programming language, (particularly one for programming a smart device). It's a way of programming ourselves or of changing our programming. Cortical columns, with their inputs, outputs and programmable (or learning) modelling intelligence are the things that we program (or that hold programs) when we learn.

> Note that a general term for the stuff that is input and output by cortical columns is *information.* An even more general term is *change.*
>
> Another important point is with respect to the term **input**. The word input throughout this book is the equivalent of sensory information whether that sensory information originates externally or internally.

2 Mind-states (Thinking and Not-thinking)

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The fluid mind-state

The not-thinking mind-state, which I'll generally refer to as **the fluid-mind state**, is the mind-state in which we focus on using our senses and responding. If you've ever enjoyed doing math and gotten pleasantly lost in the process of solving math problems, you were quite possibly in the fluid mind-state. Another way to recognize it is that you can feel extremely focused. In either of these cases this state of mind can be notable because we aren't thinking. As a result, we often don't know we are in this mind-state until we come out of it. "Oh, I just experienced some moments of not thinking. That was enjoyable. I'd like to do that again!".

Note that it can be easy to get into the fluid mind-state while doing math because if we've done enough of it we've got a mental model of what we've learned and that, through habits, drives our responses. An easy way to practice getting into the fluid mind-state is to work within the limits of short-term memory. I'll be talking about that in a bit. For now it's worth noting that switching between the thinking mind-state and the fluid mind-state is a part of building mental models and improving them.

It could also be thought of as a part of life.

Experiences of fluidity

For myself, I experience the fluid mind-state quite regularly. While I was in the army, I was studying A-level maths via correspondence course. I frequently got into the fluid mind-state while practicing different aspects of pure math. Later on during my university years, I experienced it while speed-skating. On some occasions it was while skating on the Canal in Ottawa in uncomfortably cold (frigid) weather, or atop the mountains at the outdoor oval in Lake Placid. Often it was simply enjoying the feeling of gliding from skate to skate. I once got so lost in a skating drill at the local arena, I forgot that I'd just been dumped.

I started learning Chinese calligraphy a long time before I moved to Taiwan. I got into the fluid mind-state repeatedly painting verses of the Dao de-ching in Chinese. I did have to memorize it first, and I did have to practice, but once learned, I would paint the whole thing without thinking while in the fluid mind-state. It was like watching myself paint.

It was while learning Tai Ji that I connected the idea of the fluid mind-state with that of focusing on sensing (and responding). It took a lot of practice and frustration but I realized that often I was simply repeating the movements by habit. I wasn't focused on feeling them. The trick I adopted was to make micro-adjustments, small repeated movements that allowed me to find the position where the tension in my connective tissue felt just right. This was something I later started teaching in my yoga classes with the result that my students started to get into the fluid mind-state as well.

One of the main aspects of making learning enjoyable is to make it easy to get into the fluid mind-state while memorizing, learning or practicing. It can then be easier to get into this same mind-state while doing.

The day-dreaming mind-state

Since it can be conducive to intuition one other mind-state that should be mentioned is the day-dreaming mind-state. This too is a mind-state that is notable for a lack of thinking. It differs from the fluid mind-state in that in this mind-state we aren't engaged with what we are doing. We aren't sensing, nor are we responding.

As with the fluid mind-state this one can feel refreshing both while in it and when we come out of it.

3 Habits

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No time to think

In some situations we haven't got time to think. Catching a ball, or returning a tennis ball, in either case the ball can travel so quickly all we have time to do is act. Habits allow us to act, and either catch the ball or return it without having to think.

So that we increase the chances of catching or returning the ball we can train ourselves to watch the ball. We can also train ourselves to watch our partner's posture and positioning as they send the ball (whether via throwing or the use of a racket).

Watching the person throwing and the ball itself, relevant mental models operate our body in such a way that maximizes the chance of us catching the ball.

Likewise, watching our partner's (opponent) position relative to the ball, and the way they hit the ball, as well as watching the ball itself, mental models relevant to tennis operate our body so that we ideally get in a good position to return the ball, perhaps even in a way to try to win a point.

Answering math questions quickly

At one time I had a daily practice of answering 100 simple math questions as quickly as possible. It was part of a program for **Training the Brain**.

After several weeks of doing these question sheets, I thought I would try to answer 100 questions in under 2 minutes even though I thought it was impossible.

I knew I wouldn't have time to think, but I tried it anyway, just looking at the questions and writing the responses instinctively. I didn't expect I'd get any of the answers right. I just thought it would be fun to see if I could write that many answers within the time limit. And so I was surprised to find that a lot of the answers, in fact, most of them were actually correct.

That's when I realized that with simple math, when we've done it enough times, we don't figure out the answers to questions. We memorize them (like memorizing the multiplication tables). And if we've memorized something, we can output answers (whether as a thought, a vocalization or via writing) without thinking, habitually or via habits.

Negligent Discharge

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My first experience of riding (without the necessary habits)

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Habits as options

I developed the notion of habits as options while learning a movement practice called *The Dance of Shiva*. This was something developed by a teacher who also developed a style of yoga called *Universal Freestyle Yoga*, Andrey Lappa.

Given a set of eight positions for each arm (for a total of 64 positions in total), at each level of this practice you learned a particular set of movements. With enough practice, these became habits.

The way that Andrey described it at the time was that at each higher level, you learned new movements from the same positions. At level 1 you might learn how to move from position 1 to position 2. But then at level 2 you learn how to move from position 1 to position 3. In level 3 you learn how to move from position 1 to 4. In his words, at each level you break the habits learned in previous levels. My own thoughts were that we weren't breaking habits, we were learning options.
(**Note, that this description is a vast simplification**.)

We may tend to think of habits as things that we can't control. One reason is that these uncontrollable habits are our sole responses to particular inputs or **triggers**. We have only a single model handling the particular inputs that this uncontrollable habit responds to.

A way around this is to develop other habits that respond to these same **trigger**. We then develop options. These additional habits enable us to choose how we respond.

Reducing frustration via habits

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Bothersome tasks and yoga poses

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Sudden knowings, an output of mental models

Sometimes mental models output physical responses, at other times they output what can seem like intuitions or sudden knowings. Sometimes it's a combination of both. So for example, a simple math model senses the equation two plus two and outputs the response as a physical response causing us to write the answer, or we say the answer, or we simply know it.

Working with slightly more complex models, say of an external system, we might be a customer service rep talking to a customer, and thus hearing the problem with their system. Our model of that system processes what they say and drives what we say in response, helping them to understand the problem and fix it.

Perhaps a customer requests a change in layout of the system. Learning what changes are involved, and assuming we've put the time into building our model and training it, our model can suggest possible solutions. It is as if our model is intelligent.

Intuition as a model output

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Building intuition

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Inner space

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Expanding fully into the imaginary or fully into the real

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Habit override

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Making practice more enjoyable

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4 Fast feedback

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Noticeably out of control

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Even more noticeably out of control

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Still out of control

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Extreme Feedback

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Buying the answer book

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Misplaced commas, semi-colons and the letter S

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Noticeably faster

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Noticeable slower

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Noticing with the thinking mind

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5 Noticing (and learning) how things relate

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Bench Fitting

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Writing neatly

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Brush strokes

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Learning to draw

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Kendo and Dancing

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The dolphin kick

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Natural alignment

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Balance

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Stability and room to move

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Reference frames

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6 Short term memory

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It only holds so much

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Chunky Learning

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Short-term memory limits

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Recognizing sufficient practice

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Memorizing brush strokes

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Breaking things down

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Embedding in long-term memory

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Recognizing

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Notes on memory limits

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Isolating: Learning to ride a motorbike

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Making choosing easier

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Playing around

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Breaking down rifles

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Learning to program

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My first taste of python

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Learning a sequence of yoga poses or movements

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Learning Tai Ji (Arm movements)

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Learning Tai Ji (Weight shifting)

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Muscle Grouping via attachment points

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Isolated Muscle Head function

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Breakdown and isolate to learn

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Breaking down Chinese characters

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Limits enable learning

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Two points of view with calculus

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Breaking things down

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Integrating

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Learning effectively while reading

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If we have the book why learn it?

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Figuring out what each part is about

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Figuring out the two points of view

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An example of poor indexing

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More de-contexting

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Typing is faster than looking up

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Fail safely

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Recognizing completion while prototyping or creating

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Levels or types of practice

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Practicing thinking

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Using limits to become less limited

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Defining limits via thinking

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Checking what we've done

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Fixing the model to fix its outputs

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Maintaining the flow

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Two mind-states, two points of view

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Sensing limits in the fluid mind-state

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Time as a river through space

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The journey and looking back

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Stopping to check our map

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Complex numbers, the root of -1

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Real and imaginary space

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How to be like water

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Swift, Python and Node JS

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How about an app?

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Adventures in data storage

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Python to the rescue

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It's a web app (I think)

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Well why not build a web server

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Teaching yoga

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Selecting a computer

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Selecting (and unselecting) an iPad

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Deselecting a place to eat

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Define the problem

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Learning is part of problem solving

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Loon

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Resting is necessary

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Why we learn systems

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Components

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Defining and Redefining Systems (and Models)

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Fracticality, choosing a practical scale for break down

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Ignoring the obvious

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A Dauntless approach to learning

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Undestanding an idea

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Systems as ideas

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Being like water

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Thinking clearly in terms of ideas

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Fault finding a custom built Harley

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Learning to feel and control muscles

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