Chapter 29

Psychology: Learning

This section discusses (1) Learning Models and (2) the relationship of the Langer Protocol to Learning Capacity.

29.1 Learning Models

There are two contrasting learning models in the literature of significance to this section. *Rote Instruction/ Learning* whereby an instructor repeats an activity to the student and the student attempts to replicate this activity over many trials, with the instructor correcting the student frequently. There is no stated purpose for the activity other than to follow instructions. The student is not allowed to deviate from the instructions or to experiment with variations on the instructor's directions. A second approach, *Mindful Instruction/ Learning* which utilizes the Langer Protocol, see Table 29.1, allows for experimentation, exploration and individual initiative organized around a meaningful purpose. The Langer Protocol was developed from the research of Professor Ellen Langer at Harvard on the human learning process [76], [77]. A sixteen year research project [31], was undertaken to empirically study the differences in these two approaches using the Langer Protocol. The mathematical model for each approach have similarities but differ in the parameter that represents the capacity for learning.

There are three components in a simple learning model. (1) a learning capacity term that is the analog of the carrying capacity of the environment; (2) an interaction term analogous to a prey-predator encounter; and (3) a student and teacher presence. Using the empirical model, Fig. 29.1, a learning model can be derived. Figure 29.1, [80], page 256, provides an empirical model that should be reflected in any analytical model because the learning graph in Fig. 29.1 is representative of a student learning a new skill or solving a problem by experimentation and exploration guided by relevance and purpose. If the fish is removed and the cat only relies on trial-and-error to escape, the learning time will be extended. The fish provides purpose. If a rote system is used in which the cat is constantly corrected, the cat will become confused and escape time will be extended. Also, the cat will become confused because he has no idea of what the instructor is trying to convey in the absence of a purpose. The time series for this model is presented in Fig. 29.2.

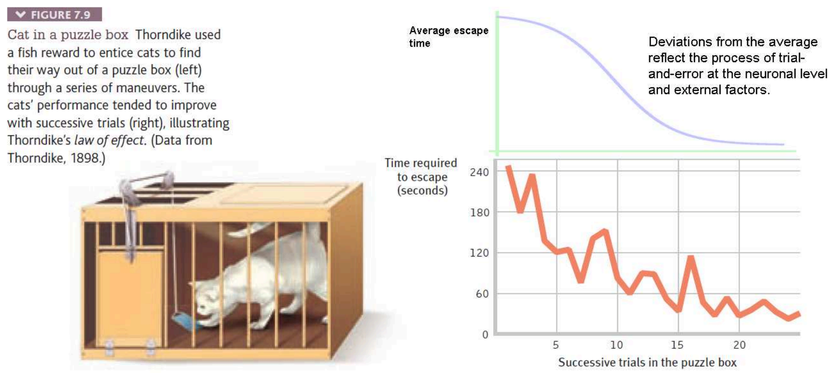

Figure 29.1: Learning by purpose and experimentation from [80]

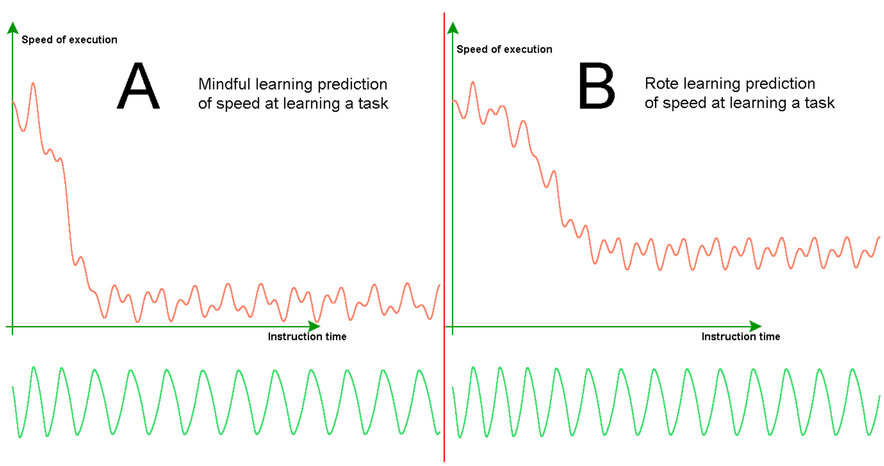

Figure 29.2: Mindful learning prediction curves. Plate A Mindful Learning; Plate B Rote Learning

1	Encourage experimentation and exploration
2	Eliminate value judgments
3	Emphasize discovery
4	Stress Individual initiative and creativity
5	Establish conceptually clear purposes
6	Eliminate *should* as a mindset
7	Eliminate micromanagement
8	Stress that answers are neither right nor wrong

Table 29.1: Principles of the Langer Protocol

$$
\left.
\begin{array}{rcl}
 & & \textbf{The Code for Fig. 29.2, Plate A is as follows:} \\
M & = & 1000 \\
h & = & 1/M \\
\alpha_1 & = & 0.3 \\
\alpha_2 & = & 0.9 \\
 & & \\
\beta_1 & = & 0.5 \\
\beta_2 & = & 0.2 \\
 & & \\
a & = & 0.5 \\
a_1 & = & 1.0 \\
b & = & 1.8 \\
 & & \text{For i = 1 to N} \\
 & & \\
z & = & z_1 \cos(\sqrt{1.1}\pi h) + w_1 \sin(\sqrt{1.1}\pi h) \\
w & = & w_1 \cos(\sqrt{1.1}\pi h - z_1 \sin(\sqrt{1.1}\pi h) \\
z_1 & = & z \\
w_1 & = & w \\
 & & \\
q & = & 0.5\cdot(1-\tanh(12\,(a-h-y))) \\
p & = & 0.5\cdot(1+\tanh(12\,(a-h+y))) \\
s & = & p\cdot(s+q-s\cdot q) \\
 & & \\
u_1 & = & \exp(h\cdot((\beta_1\cdot y+\alpha_1\cdot(b-x^2))))\cdot(x-a)+a+0.00005\cdot w \\
v_1 & = & \exp(h\cdot(\alpha_2\cdot(a_1-y^2)+\beta_2\cdot x))\cdot(y-a)+a \\
 & & \\
u_2 & = & \exp(h\cdot((\beta_1\cdot y+\alpha_1\cdot(b-x^2))))\cdot(x-a)-a+0.00005\cdot w \\
v_2 & = & \exp(h\cdot(\alpha_2\cdot(a_1-y^2)+\beta_2\cdot x))\cdot(y+a)-a \\
 & & \\
x & = & s\cdot u_1+(1-s)\cdot u_2 \\
y & = & s\cdot v_1+(1-s)\cdot v_2 \\
 & & \textbf{Plot Point} \\
 & & \text{Next i}
\end{array}
\right\}
\qquad (29.1)
$$

The significance of the mindful learning model is that it is the carrying capacity (learning capacity) of the individual's intellectual environment that is the critical parameter. If an individual has self doubt, then, on the average, their learning capacity is lower than an individual without self doubt. If there are learning boundaries within a culture, the learning capacity will be reduced. This would include political culture. The individuals who will be most productive are those for which the limitations of the intellectual environment are minimal. Specifically, the potential to experiment with new ideas, innovate and defy authority increase the learning capacity of the individual. Why these activities can be limited by the cultural environment can be traced to the associative structures in the human brain. Thought proceeds by association. The mesoscopic structures discovered by Freeman [45] and analyzed in the work of Kozma and Freeman [74] represent the building blocks of thought. These mesoscopic structures do not exist in isolation from structures that are related to emotion and fear. Therefore a cultural environment that provokes fear or concern for one's welfare links actions such as innovation to mesoscopic structure linked to culturally established structures that invoke fear. In short, fear for one's safety can block innovation and discovery. When fear arises from threats within a culture, they have the capacity to significantly limit mindful learning. In short, the learning capacity of an individual is causally limited by their culture. This parameter can be changed by cultural changes.

Additionally, early childhood environment can limit the learning capacity of the child. This can be overcome by environmental changes. The most serious conclusion of the model is that a child born in an economically limited environment will necessarily have their learning capacity limited until steps are taken to alter the limitations of the environment. The work of Freeman [45], [46], [47] demonstrates that environmental change can alter the growth of mesoscopic components related to the human learning process.

29.2 Learning Capacity and the Langer Protocol

The work of Freeman and Kozma demonstrates that it is mesoscopic components that are the elementary units of learning. Further, the global structure of the brain [67] makes clear that the mechanism of association is the dynamic that links components together to form larger action constructs or concepts. Association can also limit the formation of larger concepts if any mesoscopic component forms an association to a fear component. Culture is capable of creating associative links between mesoscopic components and fear thus blocking complex concept formation. Therefore blocking associations limit learning capacity. The Langer Protocol is precisely structured to restrict the formation of blocking associations and thus allows for a much wider range of thought. The dissolution of blocking associations may be considered a guiding principle of mindful learning and the Langer Protocol.

29.3 Nature versus Nurture in Learning

The Langer Protocol is inherently a method of nurturing learning. In addition, there is also a nature component of learning. This is the genetic structure that exist at birth. It is composed of glial and neuronal mass and their associative structures. Included in the natural dynamics of the brain is the ability of the brain to conduct random searches in an effort to form useful associative structures. This dynamic is driven by intentionality. However, as discussed in Section 10.1, randomness is a metaphor. The correct process is chaotic. As demonstrated in Chapter 7 the range of chaotic process is is very broad. An open question is whether the particular type of chaos is nature or nurture.

The bottom line is that learning capacity has both a nurture and nature component in any learning model. Learning capacity may be divided into nature and nurture in any model with the nature component having a chaotic component. As a result, learning capacity is not a fixed/ constant parameter, but is variable. This dynamic can be measured using the Langer Protocol. Specifically, learning capacity which cannot be accounted for by nurture must be considered nature and modeled accordingly. Twin studies may provide a method of measuring the nature component of learning capacity. In place of using statistical methods to account for variation in measurements, variation should modeled as chaos.

29.4 Linking the KIII Model to Learning Capacity

The simplest link between mesoscopic brain dynamics and macroscopic human action is through the learning capacity of the individual.

Learning capacity is a function of the brain's associative processes used to access a diverse range of concepts. This requires a chaotic dynamic. As seen in Chapters 7 and 11, chaos can vary widely from simple to Bernoulli. This spectrum is related to the individual's ability to learn.

The EEG needed is one that captures the range of association based on a simple image input to the subject. This has a possible connection to a subject's response to a Rorschach test in which the objective is to have an individual give multiple responses. The number of responses is related to the associative dynamic of the individual's brain and is a measure of the individuals random access dynamic, which as Chapter 19, shows is a chaotic process. The volume of responses and their diversity is the metric of interest. That metric is related to the learning capacity of the subject.

Using the Langer Protocol, one can measure the improvement in learning capacity from an initial baseline established at the start of the project.

This research may provide a link between the KIII theory Section 26. and learning theory, Section 29.