

Automaticity Research

One of the first studies involved the development of the capacity to send and receive telegraph messages (Bryan and Harter, 1897, 1899). Bryan and Harter (1897) studied novice, average, and experienced telegraph operators and found that there were alterations in the conscious processes used in sending telegraphs with Morse code (an alphabet whose characters comprise combinations of dots and dashes). It takes about two and a half years to become an expert but the majority of the telegraphic alphabet was learned within hours or, at most, a couple of days. Simple letters were acquired first (“E,” for instance, is a single dot) and more complex ones last (e.g., “Q” is a dot, dot, dash, dot combination). In the actual operation of the key apparatus the letters had to be relearned a number of times due to difficulties associated with the back stroke (the return phase of the telegraph key). Sending and receiving certainly became easier with practice but there were also qualitative reformations. As speed in receiving was achieved, the space between the letters composing a word was so reduced that it was difficult to recognize consciously. The letters appeared to meld together; the word was detected as a whole rather than individual letters. Simple and frequently recurring words were the first to have their individual letters merge. Over time and further practice, the conscious unit became the sentence.

It was found that with considerable repetition and exercise that the focus of attention shifted. Having increased the unit size, the person is no longer conscious of the effort that was applied originally to coding of the single letters, to wit, remembering the code and translating that into motor movements with the key pad. Observations of the developmental trend indicated plateaus in the learning curve that meant that there were very slow rates of increase. At the beginning letters and words were learned so rapidly that no plateau existed between them but over the next few months it was only words that were being attended to. The plateau was continued until the vocabulary had been so well practiced and acquired that attention could finally be freed for other demands, moving on to the acquisition of language habits that had a higher complexity.

A hierarchy of habits may be described in this way: (1) There are a certain number of habits which are elementary constituents of all the other habits within the hierarchy. (2) There are habits of a higher order which, embracing the lower as elements, are themselves in turn elements of higher habits, and so on. (3) A habit of any order, when thoroughly acquired has physiological and, if conscious, psychological unity. The habits of lower order which are its elements tend to lose themselves in it, and it tends to lose itself in habits of higher order when it appears as an element therein. (Bryan and Harter, 1899, p. 361)

The procedure has been so well rehearsed that it is done with little, if any, thought to the necessary motor movements. The process became automatic and involved little or no conscious attention. In fact, “The real expert has all the details of the language with such automatic perfection that he gives them practically no attention at all” (Bryan and Harter, 1899, p. 352). So common was the tendency for the skill to become automatic that

dispatchers for railways had to confirm that orders for trains had not only been received but understood and followed correctly in order to prevent mishaps.

Examining the transformations that are apparent in the acquisition of telegraphic encoding it is apparent that there were qualitative transformations that were undergone in advancing from novice to expert. Bryan and Harter even allowed that such reconfigurations are quite common. As they put it, “It is, however, now well-known that *nature does make leaps*. It may even be that saltatory change [characterized by leaping] is the rule” (1899, p. 371, emphasis added). The phenomenon had been found to exist, for instance, in the acquisition of Braille reading, as well as in developing skills at mathematics, chess, checkers, music, and other skills. In all cases there was a period of discouragement as practice appeared to be having little effect—the plateau—and then, after persevering, a quick ascent to a new level of performance. Something comparable was found by Book (1910) in the acquisition of the skill of typing.

In a study on the transformation of attentive cognition into imageless thought, Book (1910) had participants learn to type, without instruction as to how to go about it, by either the touch method (keys not visible) or the sight method (keys visible). Using trained observers (introspectionists) Book conducted a “cross-sectional analysis” that provided an historical record of the learning process and of any qualitative changes that were apparent. Subjects provided retrospective reports of their conscious experiences while engaged in acquisition. They would also record any relevant experiences while they engaged in the learning procedure. The data suggested that there were changes that took place in the conscious attitudes of the beginner that involved a shift from incompetence to becoming accomplished at the method.

At the start of the learning process, conscious attention was focused on the actual letter to be typed, on searching for the letter by the action of hands and fingers (touch method) or of hands and fingers in conjunction with sight (sight method), and the pressing of the appropriate key. Each key press was, initially, a separate action and directed by an involved consciousness. In time the presence of a to-be-typed letter would elicit a reflexive keystroke that involved a coordinated movement of hand and finger with key, an action that was directed and under personal control. As the skill was strengthened and improved such operations were less clearly represented in consciousness until a point was reached where the performance was engaged in without any need for conscious attention; its direction was taken up by non-conscious (imageless) thoughts.

A careful examination of the data . . . showed that the “mental adjustments,” “sets of mind,” “determining tendencies,” or conscious attitudes which were operative in the more advanced stages of the practice, represented, and, in fact, were nothing more nor less than the developed forms of the representative processes or images, operative as directing forces in the early stages of the writing. It was clearly determined that all the images which appeared in the different stages of the writing to initiate, guide, or direct the movements, were first prominent and distinct, then hazy or vague, giving way, finally, to the mental adjustments, sets of mind, determining tendencies or conscious

attitudes which later initiated and controlled the writing movements. The conscious attitudes developed by our subjects in learning to use a typewriter, therefore, represent the developed or automatized forms of certain definite representative processes, made imageless through much practice or use. (Book, 1910, pp. 387–388)

What were formerly separate, uncoordinated, isolated acts became a singular movement series. The letter-typing movements ran so closely into each other, after sufficient experience, and performed so rapidly, that it became impossible to be aware of or follow those individual movements. Nothing of the early hunting and pecking, of the temporally drawn out searching, or of the numerous errors was suggested in the skilled performance of the practiced typist. The structure of the cognitive processes had been reconfigured. These “sets of mind” that were established through learning sank their operations to the subliminal level and that made it impossible for the learners to describe, let alone analyze the processes involved. The study of the practiced typist, in light of this, would display nothing suggestive of the changes that had been undergone. There may be no hint in the developed skill of those struggles-of-acquisition that led to the skilled performance nor of the changes that were undergone.

Another relevant study, one that was conducted after Vygotsky had passed away, was the interference effects of practiced reading, on a color identification task identified by Stroop (1935). The task to be performed was relatively simple, yet, to the accomplished reader, it proved to be exceedingly difficult to remain within the bounds of the problem as set out. All one had to do was to identify the color of the ink of a printed word, ignoring the word. When the word itself was a color word, e.g., red or green, and that color word was inconsistent with the color of the ink, the task became exceptionally difficult. The power of the printed word overrode the power of the task instruction. Color identification slipped, unintentionally, and automatically, into reading. Reading had become so well practiced that the person slid into it without conscious intent and that resulted in a failure to perform the task. The strength of the word-reading response was better established and stronger than the color-naming response. The task, in Stroop’s opinion, was performed rapidly and required little attention, and that facilitated the unintentional passage over and into reading. Try it yourself at this interactive web site: <https://faculty.washington.edu/chudler/java/ready.html>.

That the automaticity of the reading response was involved was suggested by the fact that the interference effect began when children commence reading around the second or third grades (Galotti, 2004). After all, if you haven’t learned to read the printed word the word cannot have this interfering effect. It would be comparable to asking someone who doesn’t read Chinese to do the same task with Chinese pictographic characters as the color words. I, being one who does not read such characters, would be unlikely to suffer interference from them.

For our purposes, what we need to remember with Stroop’s interference task is that it is not a matter of not reading and then reading. Intervening developments stand between the incapacity to read and the ability to do so. Reading, mostly, is acquired at school, under the guidance of a teacher with a reading program, and with reading materials of varied complexity (Itzkoff, 1986). Training programs need to build various skills such as the identification and pronunciation of letters and letter combinations, and an appreciation of

special cases e.g., the “ph” combination having an “f” sound. Besides that, the child needs to distinguish between a sentence’s beginning and end, to understand punctuation, and how to proceed through a book (where the starting and end points are). Cognitively, another function the child requires is a developed short-term memory so that what is being read feeds into what has preceded it. Without retention, subsequent materials may not make sense due to lost continuity. Furthermore, an effective working memory aids in the comprehension of complex sentences or even in guessing what unusual words may mean, given the context of a sentence (Matlin, 2002). All of this takes time and effort. One does not go immediately from not reading to suddenly reading. For reading to become automatic considerable skill and practice is required.

References

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