Reflections on Edward L. Thorndike

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One could say that the beginning of the era of behaviorism was marked by the ringing of a bell. In the last decade of the 19th century, Pavlov and his dogs established the notion of classical conditioning. Then, in the early 20th century, Watson founded the psychological school of behaviorism on the physiological phenomena that Pavlov had helped uncover. Watson was issuing a direct challenge to “introspective psychology” which claimed to study consciousness, something Watson felt was indefinite, unobservable, and therefore utterly useless (Watson, 1930, pp. 1–2). Behaviorism, on the other hand, would take as its subject matter the “behavior of the human being” (Watson, 1930, p. 2), which is observable, and would use the explanatory tools of “stimulus and response” (p. 6).

What of education? If human beings are understood through the examination and experimentation of behaviors, and these behaviors are explained in terms of stimulus and response, then what impact does this have on teaching and learning? This question brings us to the work of Edward L. Thorndike, a man who believed that the explanatory and controlling power of behaviorism held vast implications for education which he described as the “production and prevention of changes in other human beings” (1912, p. 2). Relying on two of Thorndike’s written works, this paper will examine his fundamental laws of learning, his portrayal of how and what learning is, and his view of thinking and how it relates to “higher order” intellectual skills such as problem solving.

1 All citations, unless otherwise indicated, refer to Thorndike or Thorndike and Gates.
Laws of Learning

Behaviorism is grounded on the interplay of stimulus and response (Watson, 1930). A person is hungry and so goes in search of food. A loud thunderclap sounds and a person shudders. Someone brings up mathematics and another person rolls his eyes. Our actions, a behaviorist would explain, are built up from complex webs of stimuli and responses that have developed over the courses of our entire lives. This web begins with innate reactions (e.g., the sucking response or fear of loud sounds) and then builds as a person reacts more and more. Of course, not all reactions are maintained to the same extent (1929, p. 87). Indeed, some reactions bring about an undesirable state of affairs and so are not likely to be repeated (e.g., looking in the coat closet for food which wastes time and does not relieve the hunger stimulus). Contrastingly, some reactions produce a favorable state of affairs and are thus more likely to be repeated in the future when faced with a similar stimulus (e.g., opening the refrigerator).

Thorndike exemplified this law of effect not with a human in search of food, but with a hungry cat in a box (1929, pp. 86-87). The hungry cat can see food outside the box but must execute a particular action to gain access to the food. In this hungered and encapsulated state, the cat reacts in many different ways. Over several trials, however, nearly all of these reactions are rejected by the cat and only the actions that provide access to the food are retained. This sort of natural selection of reactions is “the most significant of all the fact of learning which need to be heeded in education” (1929, p. 87). Educators should be sure to associate reactions that are desired in their students with satisfying outcomes. Conversely, educators should associate undesired reactions
with annoying or unpleasant outcomes. Thorndike called the law of effect “fundamental” with regard to learning (1929, p. 88).

The degree of satisfaction or annoyance mentioned above is mediated by the wants of the individual at the moment, and “[h]uman wants are not equally acute at all times” (1929, p. 88). This leads to the law of readiness which states that satisfaction is achieved in an action that the individual was ready to undertake, and annoyance is achieved in an action that the individual was not ready to undertake. Furthermore, annoyance results from inaction when an individual is ready to act, and satisfaction results from inaction when an individual is not ready to act (1929, p. 89). Since “a pupil will not long show an interest in an activity which brings only difficulty” (1929, p. 91), it is imperative that educators keep in mind the law of readiness. It should also be noted that, for Thorndike, readiness refers to the “degree of craving for a particular activity” (1929, p. 89). Since some cravings come and go (e.g., hunger, cold) it would be more productive for educators to rely on cravings that are nearly always present (e.g., the desire to succeed or to be socially accepted) (1929, p. 89).

There are two more factors with regard to learning that I would like to mention in this section, even though Thorndike did not identify them as “laws.” They are practice and transfer.²

Thorndike wrote that practice is not a law of learning but a “necessary condition” (1929, p. 93). It is through practice that the desired reactions of pupils can attain permanence. Thorndike warns, however, that practice must be accompanied by

² Another factor of learning for Thorndike is concomitant learning—the learned reactions that are unintended or other than the primary objective. Because of space considerations, I did not include a development of this concept in the current paper.
satisfaction or else the experience of practicing “may kill off a response” (1929, p. 93). But practice with satisfaction can “make perfect.” Moreover, it is through practice over extended periods of time that simple reactions can be built upon and expanded into complex skills (1929, p. 94).

If learning deals primarily or exclusively in reactions (more on this below), then it becomes necessary to consider “the extent to which a reaction made to one situation will transfer to another” (1929, p. 101, emphasis added). While Thorndike admitted that transfer depends upon several factors including the characteristics of the training and the traits of the individual learner, he wrote that as a general rule reactions may transfer to other situations that are in many ways similar to the original situation in which the reaction was developed (1929, p. 102). An example of transfer could be found in a student who is trained to distribute quantities multiplicatively in algebraic expressions (e.g., \(2(x + 4) = 2x + 8\)) and is subsequently moderately successful in also distributing quantities divisibly (e.g., \((x + 4)/2 = x/2 + 2\)). They have transferred that skill to a certain extent and were able to do so because of the similarities of the situations (e.g., the presence of the same variable and parentheses, the context of a mathematics class). However, Thorndike also pointed out that transfer can be negative or detrimental (1929, p. 103). Continuing with the algebraic example, a detrimental transfer would occur if a student applied their learned skill to a similar but inappropriate situation (e.g., \((x + 2)^2 = x^2 + 2^2\)). This can be understood because many similarities exist between this inappropriate situation and the original (e.g., the same ones I mentioned above with regard to the appropriate transfer to the division case).
Now, Thorndike would say that “bright” students are less likely to make these transfer errors because they will perceive the significant differences in the situations to which they are reacting; whereas “dull” students will be more prone to transferring skills obliviously (1929, p. 104). Conversely, bright students are more likely to recognize and execute appropriate transfers of reactions whereas dull will make more narrow interpretations of the applicability of their reactions. Thorndike’s discussion of natural “intelligence” in such terms moves me to take a closer look at his underlying conception of learning, and what he thought of thinking.

Learning, Thinking, and “Higher Order” Mental Tasks

“Learning goes on during a process of reacting and...what a person learns is a reaction” (1929, p. 85). This single sentence from Thorndike actually contains two important claims. First, it posits how learning occurs; second, it posits what is being learned—in both cases the answer is reactions. This reduction to reactions is consistent with Watson’s view that all psychological phenomena, which would include learning, can be cast “into terms of stimulus and response” (1930, p. 22). Reduction, however, does not imply simplicity. Thorndike in fact points out the opposite when he explains that the learning of any function involves nearly “all the types of actions of which we are capable” (1929, p. 97) occurring together in concert. He gives the example of writing, which is primarily learned in one hand. An attempt to write with the off hand will bring to the fore all the points of action—fingers, wrist, arm, neck—that are involved (as well as less noticeable things such as respiration). This set of reactions, which Thorndike claimed are learned through reacting, is far from simple.
But what of thinking? Is thinking, which seems prima facie to be far more complex than the physical act of writing, also merely built up from and composed of reactions? Behaviorism as originally conceived suggested that what we call thinking is none other than talking to oneself (Watson, 1930, p. 238). Thorndike took a slightly more nuanced approach to the phenomena of thinking. For one thing, he acknowledged different forms of thinking (e.g., recollection, reflection, creative imagination, problem solving) and in doing so seemed to suggest more than simply different ways in which one talks to oneself. He maintained, however, that thinking, like all other behaviors, stems from learned reactions to stimuli.

Thorndike wrote that purposeful thinking (i.e., controlled thinking toward some end such as solving a problem; 1929, p. 130) has three bases: information, sagacity, and skills. He described each of these in the language of reactions. Information is “the ability to react” with an awareness of facts contained with the problem situation. Sagacity is “the intellectual capacity to perceive” the relations between the pertinent facts (note that perception is a behavior). Skills are learned reactions that allow one to manage thinking as it occurs (1929, p. 130). Let us examine each of these bases of purposeful thought individually.

Education, according to Thorndike, is well suited to increase and promote the informational basis of students’ thinking. “[F]acts which are relevant to the problems which children and adults are likely to need to solve” can be taught in the school of behaviorism and can be taught so that they come to mind in those particular problem situations (1929, p. 131). (Regarding whether or not the facts come to mind in similar but non-identical problem situations, see the section on transfer above.) By presenting
problem contingencies and pairing this with the appropriate facts, the stimulus-response connection can be made in the reaction patterns of the students. But Thorndike himself admitted that reacting to situations with particular facts is not enough to solve most problems—problem solving requires complex “manipulation of the facts” (1929, p. 132). This brings us to sagacity.

How well does Thorndike’s theory account for the complex reasoning and thought processes involved in non-routine problem solving? Problem solvers can make connections between facts that have been disparate in their past experience, they can reverse course and take a completely novel approach to a solution, and they can also have what is described as a burst of insight that allows them to interpret the problem in a completely new way. Many problem solving behaviors rely on what we now refer to as metacognition—thinking about and directing one’s thinking. The notion of metacognition is similar to Thorndike’s third basis, thinking skills. Thorndike wrote that education could build up the reactions involved in thinking skills and thus improve students’ thinking (1929, p. 131). This could be done by, for example, having more expert thinkers share their experiences and skill with students or by giving students opportunities for practice in thinking wherein they may incorporate management behaviors of their thinking, then experience the positive outcomes of this management, and thereby establish those reactions within their purposeful thinking.

But, though we have established that Thorndike’s theory accounts for the information and skills of purposeful thinking, we have yet to fully address the original question of Thorndike’s theory in relation to complex problem solving—the issue of sagacity. In fact, Thorndike himself essentially admitted the shortcomings of his
behavioral approach in this regard when he wrote that sagacity “depends primarily upon native intellectual endowment” (1929, p. 131). This can be taken as a concession that he does not have a behavioral explanation for the sagacity involved when people involve in purposeful thinking, as in when they solve complex problems. It would therefore be easy for me to follow suit and agree that “higher order” thought processes—complex problem solving in this case—bust the seams, so to speak, of Thorndike’s theory. I will, however, take the more challenging approach by attempting to explain the phenomena mentioned above (connecting what was previously disparate, reversing course and redirecting, bursts of insight) in Thorndike’s framework.

We have previously established how one can collect facts with regard to a problem situation. A connection that is made between two seemingly disparate and disconnected facts within this set can be explained by realizing that seemingly disparate facts are not necessarily truly disparate. It is feasible, and indeed likely, that the two or more facts that were stimulated by the problem situation have some relation within the problem solvers past experience (they were, after all, elicited by a single contingency). This particular situation, for some slight and realistically undetectable reason, brought those two facts into closer proximity than they had been before and this led to a connecting reaction.

The issue of reversing course while problem solving and setting off in a new direction was already somewhat dealt with in the discussion of metacognition above. Thinking skills of this nature can be modeled by other thinkers. They can also be learned spontaneously (which solves the problem of infinite regress suggested by the previous sentence) in the following manner. Imagine a student thinking about a non-
routine problem. He is following a chain of thought reactions that is leading him astray. Thus the activity in which he is engaged is becoming more and more unpleasant. At this same moment a stimulus emerges that is exterior to the stimuli of the problem, perhaps an itch or a hunger pain or a sound in the next room. The student then responds by leaving his chain of thought reactions regarding the problem, a response that is doubly satisfying because it alleviates his discomfort with the problem and also satisfies the external urge. Much of the problem stimulus remains, however, as do his previous thoughts which serve as a prompt for his next response, which is to think about the thinking he had been engaged in moments prior. The student talks to himself about the annoying direction he had been taking. The presence of the problem stimulus, his annoyance with his past route, and his desire to succeed in solving the problem (a craving that Thorndike identified as valuable in education; 1929, p. 89) elicit the response of setting forth from the facts in a new direction. If this behavior leads to success, which it very well might, then the reaction of pulling back and thinking about the thinking has been reinforced and may be enacted again by the student in a future, similar situation.

Regarding the proverbial “burst of insight,” I would appeal again to the immensity and complexity of an individual’s past experience. It may be that previous contingencies connected a particular reaction (i.e., thought) with a particular situation weakly, and then some complexity of the current contingency beckoned it forth, seemingly out of nowhere because it is impossible for us to analyze or even recognize all the facets of these contingencies. Evidence of this would be the fact, which I hypothesize to be true, that bursts of insight are never something completely foreign or
unknown to the thinker. For example, I would not have a burst of insight that the solution to a graduate mathematics problem is in the nilpotent element of a quotient ring if I have never heard of or in any way encountered abstract algebra (structurally or conventionally).

Now, if these explanations do not read convincingly, then perhaps this points to a true shortcoming of Thorndike’s behavioral view of thinking; I did, after all, make more of an attempt to keep it alive than he did in this case. And one may have an even harder time explaining in behavioral terms the phenomenon of artistic creativity. Nevertheless, this does not diminish the importance of studying the behavioral philosophy of psychology and education because it has played an important role in its history over the past century, and its influence still exists today (Shulman & Quinlan, 1996).
References


