Behaviorism reinforcement learning and its application in mathematics teaching in primary and middle schools

Zong Shan

Mathematics and Science College, Shanghai Normal University, Shanghai, 200000, China

Abstract: Behaviorism originated in the United States in the early twentieth century. Since its establishment, it has been playing an indelible and important role in western psychology because of its charm and great influence. American psychologist Woodworth once praised: "Behaviorism is a religion of religions." Although behaviorism was biased towards extreme behavior determinism in its early stage, there are still many theories which are worthy of our reference and practice in future teaching. This paper will follow the development of behaviorism learning theory, enumerate and analyze the representatives of behaviorism learning theory and its reinforcement learning theory in detail, and from the perspective of a future teacher, to give some methods of reinforcement learning in primary and secondary mathematics teaching.

Keywords: reinforcement learning, behaviorism learning theory, mathematics teaching

1. Overview of Behavioral Learning Theory

Behavioral learning theory is also known as "stimulus-response theory". The theory believes that learning is the connection between stimulus and response. Behaviorists believe that the external environment is a stimulus, and the individual behavior caused by the stimulus is a response. They believe that all behaviors are learned. The development and emergence of behaviorist psychology are divided into three stages. The first stage is the old behaviorism represented by Watson; the second stage is the new behaviorism represented by Skinner and others; the third stage it is a new new behaviorism represented by Bandura and others. Many viewpoints in behaviorist learning theory can explain some of today's human learning behaviors, and teachers can combine these theories in school education to appropriately strengthen students and promote students' learning.

2. Representatives and important theories before the establishment of old behaviorism

2.1 Overview of Thorndike's Connectionism Theory

At the end of the 19th century, Thorndike put forward the theory of trial-and-error connection through the cage experiment. He believes that the learning process of low-level animals and humans is a process of forming a connection in the process of constant trial and error. And on this basis, three main learning laws are proposed: preparation law, practice law and effect law; and five subordinate learning laws: dominant elements, mindsets and attitudes, multiple response, connection transfer, and analog response (Lei Xianhua, 2016). Thorndike also slightly modified the learning law in the follow-up research, making the learning law subordinate to the effect rate.

2.2 How to use connectionism theory for reinforcement learning

In the teaching process of elementary and middle school mathematics, teachers can also make full use of Thorndike's connectionist theory to promote students' intensive learning. First of all, teachers should guide students to make independent and active trial and error, and cultivate independent problem-solving ability and mathematical thinking ability in the process of continuous trial and error. There are often many different ways to solve math problems in middle school. Some methods can lead to correct results, and vice versa there are wrong and ineffective methods. Teachers should try to avoid directly telling students the correct methods. Letting students try and make mistakes is an effective process of

intensive learning, which can enhance the discrimination and understanding of problem-solving methods and knowledge. Secondly, teachers should follow the law of preparation, set up the problem situation first, and then introduce new knowledge. Let students learn new knowledge with questions, so that they will be more motivated and interested in learning. Again, use the practice law cleverly to strengthen and give feedback in stages. Only when learners repeatedly consolidate old knowledge and find that such strengthening exercises are effective, will it be helpful for learning. Finally, the law of effect must be followed. The effect law dictates that satisfying behaviors will be strengthened, while frustrating behaviors will be automatically weakened. Therefore, in the learning process, find the right time to praise or criticize the students, and explain the reasons to the students. In this way, the learning effect of students can be strengthened.

2.3 Overview of Pavlov's classical conditioning theory

As early as the end of the 19th century, Pavlov began to study the salivation of dogs on food under different conditions, and conducted a series of experiments by adjusting the stimulus before food appeared, and finally constructed a well-known classical conditioning theory. . The classical conditioning theory has also become the cornerstone of Watson's creation of behaviorist psychology. In the classic conditioned reflex experiment, if a neutral stimulus like a bell is given every time a dog is fed, the neutral stimulus will be combined with the unconditional stimulus that would have caused a certain response to become a conditioned stimulus. In the future, even if the dog is given a conditioned stimulus to rattle a bell instead of an unconditional stimulus to feed the dog, the dog will secrete saliva after the bell rings. Such a response is called a conditioned response. In addition, Pavlov also discovered several laws of conditioned reflex in his experiments, namely, acquisition, regression, generalization, differentiation, and advanced conditioning.

2.4 How to use classical conditioning theory for reinforcement learning

2.4.1 Acquisition

Acquisition is an important law of reinforcement learning using classical conditioning theory. The process by which an individual forms a connection between the two learning stimuli is called the acquisition of conditioned reflexes, and the time interval between the appearance of conditioned and unconditioned stimuli is the key factor that affects whether it can be learned effectively. According to the time when the conditioned stimulus and the unconditional stimulus appear, the conditioned effect produced by the conditioned response can be divided into three categories: First, simultaneous conditioned effect: conditioned and unconditioned stimulus appear simultaneously; second, delayed conditioned effect: conditioned stimulus first After a period of time, the unconditional stimulus will be presented before it disappears. Third, the trace conditioned effect: the conditioned stimulus will be presented first and then terminated, and then the unconditional stimulus will be presented again after a period of time. Experimental studies have shown that delayed conditioning is the best among the three, followed by simultaneous conditioning, and lastly trace conditioning.

We can also cleverly apply the acquisition theory to mathematics teaching in elementary and middle schools. For example, when students first come into contact with the concept of coordinate axes and coordinates, students may be confused. But we should guide students to connect abstract and visual things. For example, let students use their seat positions in the class to understand the meaning of coordinate axes and coordinates. Through such repeated intensive learning, students can establish a connection between stimulus and response. In the future, even if there is no unconditional stimulus (image seat position), when students can understand and understand the meaning of coordinate axes and coordinates, a conditioned reflex is completed. , That is, the student successfully completed an intensive study.

2.4.2 Fading

Fading refers to not strengthening the conditional behavior, which leads to a decrease in the frequency of occurrence of a certain behavior until it disappears.

The content of mathematics is relatively abstract, so it is necessary to avoid the phenomenon of fade. Teachers should pay attention to the consolidation of old knowledge when teaching new lessons and assigning homework. They cannot teach new lessons and lose old ones. The self-consciousness and self-discipline of primary and middle school students are relatively poor, and teachers need to assign homework that has been learned before, so as to prevent students from forgetting their original knowledge quickly due to non-intensive learning, which will affect the learning of new knowledge.

2.4.3 Generalization

Generalization means that other stimuli similar to the conditioned stimulus will also cause the conditioned reflex in the initial stage of the conditioned reflex. The more similar the stimulus is, the more likely it is to cause the same conditioned reflex as the original stimulus. (Zhang Mengying, 2013).

For example, when learning polygons, the appearances of rectangles, rhombuses and squares are similar. Many students tend to confuse the concepts and properties of these types of polygons. Therefore, in teaching, in order to avoid undesirable generalization, teachers should find out the differences and connections between concepts for similar concepts, and emphasize them through exercises to strengthen the knowledge learned in this part of the students.

To promote intensive learning, teachers should help students create positive generalized results. Many students are fairly relaxed in the elementary exam, but when they arrive in the major exam, they will suddenly become nervous and perform improperly. Teachers can guide students to generalize the big test and the small test, and create the same pattern as the big test in the small test, so that the students remain nervous and excited, so that they will not feel very abrupt in the big test. It may also encourage students to maintain the same relaxed attitude as the quiz during the big exam. Which method you choose will vary from student to student.

2.4.4 Differentiation

Differentiation refers to a certain response to a specific stimulus, but not to other similar stimuli.

When learning, teachers should guide students to distinguish easily confused knowledge. For example, when you have finished learning classical probabilities and are ready to learn geometric probabilities. It is necessary to enable students to consolidate the definitions and characteristics of classical probabilities again, and then to carry out the study of geometric probabilities, and to guide students to distinguish between the two conceptual differences and their different characteristics.

2.4.5 Advanced Conditioning

After the conditioned effect is formed, the original conditioned stimulus can be used as a new unconditional stimulus, and it can be used to condition other neutral stimuli. The second-level conditioned effect can be established on the first-level conditioned effect, the third-level conditioned effect can be established on the second-level, and so on (Zhang Fen, 2016).

3. Representatives of old behaviorism and their important theories

3.1 Overview of Watson's behaviorist learning theory

At the beginning of the 20th century, Watson created behaviorist psychology on the basis of Pavlov's theory and put forward his own behaviorist learning theory. His theory has been called "S-R psychology", that is, the "stimulus-response" theory. To a certain extent, Watson's theory also aims to criticize Thorndike's law of effect. Watson questioned Thorndike's law of effect at the beginning, and then through a white mouse digging experiment, pointed out the shortcomings of Thorndike's law of effect, and proposed the law of recency and the law of frequency that could replace the law of effect. . Watson's behaviorist learning theory reveals the most basic mechanism of learning activities, which can also be used well in mathematics teaching practice to promote students' intensive learning.

3.2 How to use Watson's behaviorist learning theory for reinforcement learning

3.2.1 Ingenious use of frequency law and recency law for reinforcement learning

Frequency factor law means that when other conditions are equal, the more learners practice a certain behavior, the faster they can form a habit. The law of proximity means that when an individual reacts frequently, those reactions that have just occurred are more likely to be strengthened.

But the frequency-cause law that Watson talks about must be conditional. More practice does not refer to mechanical repetition, but refers to repetitive training that incorporates thinking. Nowadays, many teachers and parents criticize children for saying that they are not good at math because they don't have enough practice. However, mathematics is a subject that focuses on thinking. Only when more exercises and training are carried out under the conditions of diligent thinking and good thinking, can the frequency factor rule be effective and can achieve the effect of intensive learning. Combining the law of

proximity and consolidating old knowledge in a timely manner can also promote students' intensive learning.

Although Watson self-denied the effect of the frequency factor law on reinforcement learning in "Psychology from the Perspective of a Behaviorist", I still think that the frequency factor law is worthy of our consideration and application.

3.2.2 Enlightenment of reinforcement learning from the "Little Albert" experiment

The Little Albert experiment conducted by Watson means that Little Albert is not afraid of small animals, but when small animals appear with fearful sounds many times, Little Albert will also be afraid of animals. The conclusion of this experiment is similar to the generalization in Pavlovian theory, which is equivalent to Watson's inheritance and development of Pavlovian theory.

This conclusion enlightens us mathematics educators that for mathematics, which is inherently more difficult and more abstract, should make the atmosphere more pleasant and relaxing in mathematics teaching. In addition, giving more encouragement and praise to children with poor math scores can also reduce the fear and escape emotions of many students in math learning. When students combine mathematics learning with beautiful and warm feelings, they will be more willing to learn mathematics and play a role in strengthening learning.

4. Representatives of New Behaviorism and Their Important Theories

4.1 Overview of Skinner's operating conditioning theory

Faced with the difficulty of explaining the variability and apparent spontaneity of certain behavioral forms, many psychologists have begun to assume the unobservable. Therefore, by 1930, many researchers proposed S-()-R new behaviorism on the basis of traditional S-R behaviorism (Yuan, H., 2012). Skinner is the founder of the new behaviorist learning theory and proposed the theory of operational conditioning.

Through the Skinner box experiment, Skinner affirmed that reinforcement plays an important role in a person's development, and reinforcement can change and shape a person's behavior. The difference between operant conditioning theory and classical conditioning theory is that in classical conditioning, the individual passively receives the stimulus and then is strengthened; while in operating conditioning, the individual performs active behavior and then gets unconditional stimulation, that is Reinforcement. Therefore, when using the classical conditioning theory to strengthen learning for students, we often don't need to consider individual differences, but give a uniform method that is the same for every student.

4.2 How to use operational conditioning theory for reinforcement learning

4.2.1 Make good use of positive and negative reinforcement or positive and negative punishment

Positive reinforcement means rewarding things you like, and negative reinforcement means eliminating negative events. Positive punishment is to provide a stimulus that the opponent dislikes, while negative punishment is to remove a stimulus that the opponent likes.

For example, students may appear careless in their calculations, which leads to frequent errors in calculations, and they do not care about it. The deduction of points in the exam is not a positive punishment for him, because he himself does not care about the scores once or twice. Therefore, in order to better help students to carry out reinforcement learning and get rid of the shortcomings in mathematics learning, teachers should change to a method of reinforcement or punishment.

4.2.2 Reinforcement learning combined with Premark principle

The Premac principle refers to the effective reinforcement of low-frequency behavior is high-frequency behavior.

For example, students do not like to sort out the wrong question books in mathematics learning, so they set up rules, such as how many wrong questions can be sorted out as many rewards. But when using the Premark principle for intensive learning, it should be noted that it cannot be overused, and it will vary from student to student.

4.2.3 Intensive learning combined with the principle of program teaching

Skinner put forward five principles of program teaching, namely: self-paced, positive response, timely feedback, small steps and the lowest error rate. These five principles are especially applicable in elementary school mathematics teaching.

Therefore, in the teaching process of elementary school mathematics, we need to consider the development needs of students at different levels, and formulate detailed intensive learning plans for each stage, and make timely responses and feedback to students' behavior at each stage and time. Pay attention to step by step from shallow to deep in teaching, so as to reduce the probability of students making mistakes as much as possible, and stimulate students' enthusiasm for learning.

5. Representatives of New New Behaviorism and Their Important Theories

5.1 Overview of Bandura's Social Learning Theory

Since the 1940s, behaviorist psychologists have been very interested in how children obtain social behavior, and they believe that people learn social behavior by observing and imitating others. In this way, the new behaviorist reinforcement theory cannot explain all the forms of imitation well. Therefore, Bandura put forward the social learning theory on the basis of research, developed behaviorism to a new stage of new behaviorism, and began to consider the impact of human subjective behavior more. The main point of Bandura's theory of social cognition is that most of human learning is alternative learning, that is, learning by observing the behavior of others. Not all behaviors can be learned by observing them. Humans will choose whether to learn by observing the consequences of this behavior in a specific situation.

Observational learning needs to go through four steps: first, attention: pay attention to the behavior you are learning; second, keep: remember the behavior you observe; third, copy: convert what you remember in your brain into behavior; 4. Motivation: Motivation is needed to imitate the behavior he observes. There are three main sources of imitation motivation: direct reinforcement, substitution reinforcement and self-reinforcement.

5.2 How to use the theory of the Department of Sociology for reinforcement learning

5.2.1 Use direct reinforcement for reinforcement learning

Direct reinforcement means that when an individual performs a desired behavior, he will be rewarded.

For example, in the teaching of mathematics in elementary and middle schools, we advocate organizing group discussions and exploratory learning, but there are always some students who are less gregarious and unwilling to engage in team exploratory learning. Then the teacher can encourage the children who actively participate in the team discussion and learning in the process of organizing the team to study, so that the out-of-group students observe that other students are rewarded for participating, the imitation motivation will be strengthened, and they will be better. Willing to participate in team learning.

5.2.2 Reinforcement learning using alternative reinforcement

Substitution reinforcement refers to the individual being strengthened by seeing others being strengthened.

Teachers should play a more role model in the process of mathematics teaching, and they should devote themselves to the investigation of problems together with their students. When students observe that the teacher is willing to think and can get the results after thinking, they will also be more confident in mathematics learning and willing to in-depth exploration and learning.

5.2.3 Use self-reinforcement for reinforcement learning

Individual reinforcement refers to rewarding individuals when they perform desired behaviors.

Individual reinforcement is not the same as the previously described reinforcement learning method, and individual reinforcement requires the learner to subjectively strengthen it. But for students in primary and secondary schools, they can often only complete direct reinforcement and substitution reinforcement. Self-reinforcement requires learners to become more mature before they can use it. But as an educator, we should try our best to guide and help these students in elementary and middle school to develop their

subjective initiative. Only when they themselves are willing to make progress and progress, all intensive learning will be beneficial.

6. Summary and Outlook

Following the development of behaviorist learning theory, this article summarizes the main theories of five well-known behaviorist psychologists, including Pavlov and Bandura. And deeply explored how to apply its theory to the practice of intensive learning in mathematics teaching in primary and middle schools.

But just like the shortcomings of early behaviorism: Behavioral learning theory tends to be extreme behavioral determinism in the early stage, while ignoring the role of heredity and the subjective initiative of people. Therefore, in the course of the development of behaviorism, it slowly developed from ignoring the subjective influence of individuals to taking into account the subjective behavior of people. In the process of teaching, teachers should also pay attention to guiding students to actively deploy subjective initiative, from teachers helping students to directly and alternatively strengthen to students slowly strengthening themselves. Whether it is mathematics or other subjects, or even in life's learning, work and life, learners should put the focus of reinforcement learning on self-reinforcement learning, and gradually reduce their dependence on others. This is not only the society's requirement for a person to be independent and mature as soon as possible, but also not only the demand for reinforcement learning for the learner itself, but also the inspiration given by psychology to all our learners: we must understand our heart, and we need to be more committed.

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