

# Drive Reduction Theory

## General

Drive reduction theory was introduced in 1930s by an eminent American psychologist [Clark Hull](#), whose works were **influenced by other behaviorists** like [Ivan Pavlov](#), [Edward Thorndike](#) and [Edward Tolman](#), but also by [Charles Darwin](#)'s theory of evolution.<sup>1)</sup> Hull's theory was at the time very influential. As a general learning theory it tried to explain **all behavior** and the likelihood of its appearance mathematically using a **set of formula**. Another area of Hull's interest was hypnosis research. He conducted a number of laboratory experiments in which he finally showed that hypnosis and sleep are two completely separate states.<sup>2)</sup>

## What is drive reduction theory?

Like other behaviorists, Hull was only interested in **overt behavior**, yet he did not deny existence of cognitive factors like ideas, prior knowledge, intelligence, insight and values. He excluded this factors from his theory since they could not be scientifically measured.

In his theory, Hull tried to explain behavior and learning through drive reduction. **“Drive”** presents a **stimulus** in form of a biological need like hunger, thirst, cold or sexual interest. It is a state of need, when a living organism feels the needs to behave in certain way to reduce the need and restore the optimal biological state. The drive therefore **results in behavior** in order **to achieve certain goal** or satisfy the need. If the goal of the drive is achieved, the **drive is reduced** and an optimal state is restored. The **drive reduction** here **is a reinforcer**, strengthening the connection between the drive and behavior.

This **reinforced stimulus-response (S-R) learning** through the reduction of a biological drive was the only kind of learning according to Hull. Because of his beliefs that a living organism would repeat a behavior that would reduce a drive, his theory was also called a **drive-reduction theory of motivation**.

Hull's theory was mostly orientated on S-R relationship and reinforcement. If a S-R relationship is followed by a reduction of the drive, the probability of same prior response on similar situations in the future increases. S-R relationship (**habit strength**) becomes stronger through the number of **reinforcements**. Biological needs were according to Hull *primary drives*, but he also believed there are *secondary drives* (learned drives), which refer to situations associated with reduction of primary drives. That means a neutral stimulus can have primary drive characteristics, because it is capable of eliciting responses similar to those caused by primary drive.

In order to offer a full, scientific explanation of learning, Hull developed a **formula**<sup>3)</sup> in which he tried to mathematically explain and **predict a likelihood of behavior**. This formula measures **habit strength** defined as the strength of the S-R bond. This bond represents learning. Hull's equation claims:

$$sEr = (sHr \times D \times K \times V) - (sIr + Ir) \pm sOr$$

Meaning of variables:

sEr - the probability, and speed with which a behavior occurred to a given stimuli (reaction potential)  
sHr - number of reinforced trainings (habit strength)  
D - amount of biological deprivation or drive measured in hours  
K - size of reward (incentive motivation)  
V - clarity of the stimulus (stimulus dynamism)  
sIr - number of non-reinforced trainings (inhibitory strength)  
Ir - number of trainings resulting in exhaustion (reactive inhibition)  
sOr - random error

Hull believed that this formula could account for all behavior in humans and animals.

Hull's theory was further developed by one of his students, [Kenneth Spence](#). Spence disagreed with Hull's assumption that improvement in performance comes only due to habit factors. In his opinion, this was the influence of motivation. He also believed reinforcement does not have a role in learning itself. **Reinforcement** can serve as motivator for learning and **enhance a response**, yet it does **not** necessarily **enhance learning of a response**. This idea was later known as the **Hull-Spence hypothesis of conditioning and learning**.

It was Spence's idea that performance in learned behavior cannot be attributed to habituation, but rather to motivational factors behind it. Learning can also occur through "latent learning". This idea would explain the fact that organisms do not always perform in accordance with what they have learned.

During his life Spence conducted most of experiments on animals. When he finally tried to experiment on human subjects, unlike his forerunners, Spence suggested humans are far more complex than other living beings. Learning theories derived from observations of non-human organisms therefore can not be directly applied to them, and additional components, especially **cognitive factors** need to be taken into account.

## What is the practical meaning of drive reduction theory?

Hull's equation suggests performance is affected by the following variables:

- sHr - reinforced trainings improve the S-R connection resulting in **learning** (of a motor skill).
- D - **deprivation of drive** results in **improved performance**. Experiments have shown that if two rats had the same amount of training, the one who had been deprived of food for a greater period of time would be more likely to find a solution to a maze in order to obtain food <sup>4)</sup>.
- K - **incentive motivation** refers to the size of the **prize** and directly affects motivation to achieve certain goal. This explains why athletes perform better in playoffs than during regular season play since the incentive motivation of each game has increased.
- V - **clarity** of the stimulus can **affect the performance**. If an sportsman is trying to catch the ball, blinding sunlight can affect clarity of the stimulus.
- sIr - non-reinforced trainings (trainings that don't result in drive reduction) cause reduction of the probability of displaying certain behavior (**extinction**).

## Criticisms

Although very often cited in the 1940s and 1950s, researchers soon started to realize Hull's equation does not always provide valid results, even if altered. Finally it was accepted that a system simple as that could hardly be responsible for a complexity of behaviors of an animal or human.

Hull's theory was mostly **abandoned by the beginning of the 1970s**, as the study of learning went in other directions rejecting years of researches based on his formula and ideas.

Still, Hull's theory was **inspiration** for a number of later theories offered by his students. Most famous of them was Kenneth Spence, who extended Hull's theory and introduced the [discrimination learning theory](#). Some **motivational theories of the 1950s and 1960s** including Maslow's [hierarchy of needs](#) were reactions to at the time dominant Hullian theories.

## Keywords and most important names

- **drive reduction theory, drive-reduction theory of motivation, drive, reinforced learning, primary drive, secondary drive**
- [Clark Hull](#), [Kenneth Spence](#)

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