

Edward Lee Thorndike (1874-1949)

Chapter 4

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Edward Lee Thorndike

1. Thorndike was born in Williamsburg, Massachusetts on Aug. 31, 1874.
2. Read "*Principles of Psychology*". Worked with James and Cattell.
3. Wrote *Animal Intelligence* (1911).



(1874-1949)

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Edward Lee Thorndike

4. The most meticulous experimental psychologist.
5. First formal learning theory.
6. Died in 1949.



(1874-1949)

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Before Thorndike

Descartes (1596-1650) Humans and non-human animals functioned similarly based on mechanical principles however this did not spark any behavioral studies in animals.

Darwin (1809-1882) Initiated animal research suggesting that humans and animals had similar anatomy, emotions and cognitions. *The Expression of Emotions in Man and Animals (1872)*, considered first text on comparative psychology.

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Before Thorndike

Romanes (1848-1894) Supported the idea of continuity of intelligence, emotional behavior anecdotally among species, anthropomorphizing human traits in animals. *Animal Intelligence (1882)*.

Morgan (1842-1936) "We should not attribute a behavior to complex cognitive processes when it can be explained with one that is less complex (Hergenhahn, 1997)". *Introduction to Comparative Psychology (1891)*.

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Washburn & Thorndike

Washburn (1871-1939) First woman to have a PhD., in psychology. Started conducting laboratory experiments with animals, but no controls. *The Animal Mind, (1908)*.

Thorndike (1874-1949) Thorndike brought methodological innovations in animal and human experimentation. Carefully described behavior with proper experimental and control conditions.

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Connectionism

1. Thorndike's theory of learning is called **connectionism**. He described it as the association between sense impressions and impulses to action.
2. Earlier on, associationism proposed linking of one idea with another (cf. Aristotle). Functional analysis of responses (R) in the context of stimuli (S) lead Thorndike to propose that S-R connection was neural in nature. First formal theory of learning.

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Trial-and-Error Learning

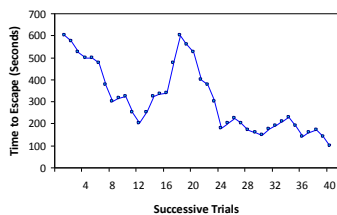
1. Thorndike early learning experiments involved training cats to escape a puzzle box. This form of learning was called **trial-and-error learning (or selecting and connecting)**.
2. The puzzle box consisted of pole or a chain hanging from the top. The cat would push the pole or pull the chain to escape out of the box.



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Trial-and-Error Learning: Results

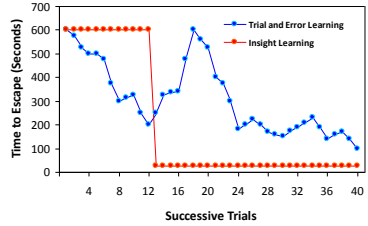
Results of the puzzle box experiment suggested that time to solve the problem decreased as a function of trials.



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Trial-and-Error Learning: Conclusions

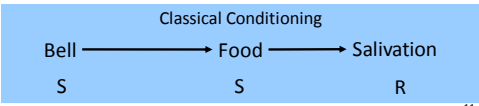
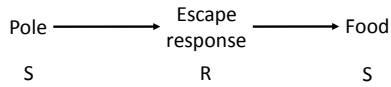
Learning is incremental (blue line) and not insightful (red line). Animal learns by doing not by thinking or reasoning.



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Instrumental Learning

In trail-and-error learning behavior is instrumental (useful) in bringing the about reinforcement.



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Laws of Learning and Concepts before 1930

Law of Readiness

When a conduction unit (animal) is **ready** to conduct (respond), conduction by it is satisfying ... not to conduct is annoying... when **NOT** ready to conduct and is forced to conduct is annoying.

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Law of Exercise

Part I (Law of Use) : Connections between a stimulus and a response are strengthened as they are **used**.

Part II (Law of Disuse): Connections between stimulus and response are weakened when **practice is discontinued**, or if the neural **bond is not used**.

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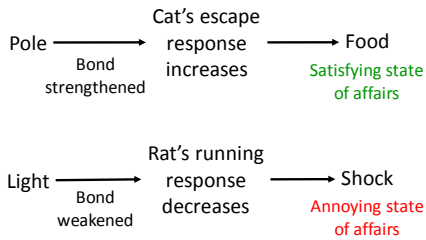
Law of Effect

Part I: A connection between stimulus and the response is strengthened if the consequence of such a connection is a **satisfying state of affairs**.

Part II: A connection between stimulus and the response is weakened if the consequence of such a connection is a **annoying state of affairs**.

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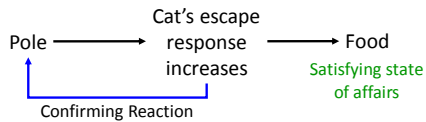
Law of Effect: Examples



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Confirming Reactions

How could a S-R connection strengthen if the conduction unit had already responded before the satisfying state of affairs occur? Thorndike suggested that a **confirming reaction** was triggered in the nervous system if a response was followed by a satisfying state of affairs.



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Multiple Response

Varied or multiple responses are the first steps in all learning. These responses that do not usually solve the problem and are discarded. In trial-and-error learning when a response solves the problem it is **stamped in** (kept), others are **stamped out** (discarded).

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Set or Attitude

Set or attitude are subject variables and are as important in a learning situation as any other variable. So what the learner brings to the learning situation is his set, **temporary conditions** (drive, fatigue) and **permanent conditions** (heredity, intelligence and previous experience).

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Prepotency of Elements

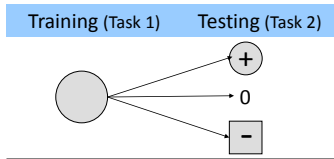
During learning the animal pays attention to the significant (prepotent) stimulus element. In case of the cat in the puzzle box, pole becomes the prepotent element for learning to escape.

Apparatus	Laboratory	Animal
Puzzle box	Light	Drives
Strings	Temperature	Temperaments
Pole	Noise	Heredity
	Humidity	

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Transfer of Training

Traditionally transfer of training generally consist of two phases, a training phase and a testing phase. In the testing phase (Task 2) the individual can show improvement (+), no change (0) or deterioration (-).



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Transfer of Training

If we learn to use a dictionary (Task 1) and later with ease use a phonebook (Task 2), transfer is positive. If we learn list of English words (Task 1) and then find it difficult to learn Spanish words (Task 2) the transfer becomes negative.

Training (Task 1)	Testing (Task 2)	Transfer
Dictionary	Phone Book	Positive
List of English words	List of Spanish words	Negative

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Formal Discipline

Faculty psychologists argued that if a mental faculty was trained on a task, it transferred to other tasks. If one disciplines reasoning (faculty) by practicing math, one becomes a better logician. So transfer of training, for **formal discipline** was based on exercising a “mental muscle”.

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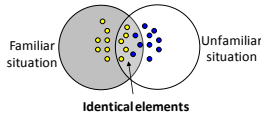
Response by Analogy

Thorndike argued against formal discipline. He suggested that responses made in familiar situations (Task 1) are analogously used in unfamiliar situations (Task 2). Responses are based on identical stimulus elements in the two situations.

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Identical Elements Theory

Identical elements theory suggests that ease of responding in an unfamiliar situation is based on identical elements (stimuli), it had with the familiar situation. The greater the number of these identical elements the easier it became for the individual to respond by analogy to the unfamiliar situation.



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Identical Elements Theory

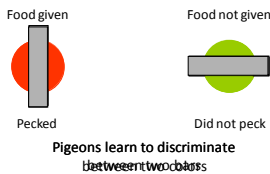
Elements in familiar and unfamiliar situations can be stimuli or procedures. Learning to ride a motorcycle after a bicycle has many common procedural elements. Thus learning to ride a motorcycle becomes an easy task.



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Associative Shifting

Associative shifting portrays response by analogy in a classical study by Terrace (1963). Study shows that pigeons continue to peck (response) for food while the stimulus pattern changes.



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Concepts after 1930

Laws after 1930

In September 1929, Thorndike stood before the International Congress of Psychology in New Haven, Connecticut and started his address by saying "I was wrong..."

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Law of Exercise

This law was totally abandoned. Practice (repetition) little affect on learning.

"The repetition of a situation may change a man as little as the repetition of a message over a wire changes the wire. In and of itself, it may teach him as little as the messages teaches the switchboard . . . The more frequent connections are not selected by their greater frequency (Thorndike, 1935)".

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Law of Effect

Satisfying state of affairs led to strengthening S-R connections. However, the other half of this law was abandoned. Punishment (annoying state of affairs) had little or no effect on weakening the S-R bond.

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Other concepts after 1930

Belongingness

In addition to contiguity and reinforcement (satisfying state of affairs) **belongingness** played an important role in Thorndike's learning theory. All those S-R connections strengthened if the elements of association somehow belonged together.

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Belongingness

10 Sentences

Lincoln Blake and his uncle listened **gladly**. Jackson Craig and his son **struggled often...**

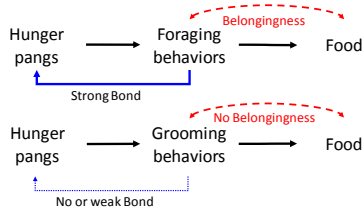
What word came after the word **gladly**? (Contiguity)
Average correct associations = 2.75

What came after the word **struggled**? (Belongingness)
Average correct associations = 21.50

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Belongingness

If reinforcers (based on a need state) and responses belonged with each other connections between S-R strengthens.



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Gestalt Psychology

1. Many thought that Thorndike was giving concessions to Gestalt psychology which said individuals learn general principle of belongingness and not specific S-R connections.
2. Thorndike rebutted; if individuals do use principle of belongingness to learn, rather than specific S-R connections, then reciting alphabets forward or backward should be equal. But recall is better forward ([principle of polarity](#)) than backwards.

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Spread of Effect

Paired List		To study spread of effect (reinforcement) the participants learnt a word associate list and as they recalled they were reinforced by the experimenter.
Stimulus	Response	
Experimenter	Participant	Experimenter
Catnip	6	Wrong
Dazzle	2	Wrong
Debate	4	Right

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Spread of Effect

1. When the participant was reinforced by the experimenter, recall increased. However when the experimenter punished (wrong) the participant recall was not weakened.
2. The likelihood of all those responses (3, 5) increased if they were close to the reinforced response (4) suggesting a **spread of effect**.

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Educational Practices

1. Educational practices should be studied scientifically.
2. Scientific knowledge about learning should be applied to these practices.
3. Good teachers know what they have to teach so they know what responses to look for, and which satisfiers to give.

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Evaluation

Contributions	Criticisms
Thorndike pioneered the scientific study of learning and proposed a formal theory of learning.	Law of effect is circular, because the organism needs to be aware of satisfying effects of reinforcement.
Proposed the backward effect of reinforcement on strengthening S-R bond. Confirming reaction.	Reduced human behavior to automatic reactions (determinism).
Discarded formal discipline	

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Science and Human Values

Thorndike defended himself against the last criticism by saying that in order to study a phenomenon like learning one needs to reduce it down so that all variables that affect behavior could be studied. Science & technology provides us with the control of these variables to bring benefit to mankind.

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Questions

15. Explain in your own words the concept of belongingness. How does Thorndike argues against Gestalt's ideas of using this concept, by using the principle of polarity.
16. What Thorndike means when he says that identical elements in a familiar and an unfamiliar situation result in the transfer of training.

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