

Comparative Psychology and the Objectification of Mind: Thorndike's Cats in the Puzzle-Box

David O. Clark

Independent Scholar, USA.

INFORMACIÓN ART.

Recibido: 29 septiembre 2019
Aceptado: 12 noviembre 2019

Key words
Thorndike,
William James,
Puzzle-Boxes,
Cattell,
Comparative Psychology

Palabras clave
Thorndike,
William James,
Puzzle-Boxes,
Cattell,
Psicología Comparada

ABSTRACT

Animal Intelligence: An Experimental Study of the Associative Process in Animals by Edward L. Thorndike contributed significantly to psychology in the 20th century. In textbooks, the experiment is attributed to Thorndike without qualification. The design looks simple and produces conviction; by trial and error, cats learn to escape from a puzzle-box. But closer reading reveals multiple controls, innovation in statistical methods, and strong theoretical interpretation. This sophistication raises questions: Did a young graduate student do this complicated experiment? Why was this expensive study funded? Is the convention now myth? This paper delves into the complex relationship between James's functionalist project, Cattell's mental testing and the comparative psychology of Morgan and Romanes, to conclude that Thorndike's experiment was the means to provide functionalism with a foundational experiment and consecrate the learning curve as the method of this scientific perspective.

La Psicología Comparada y la Objetualización de la Mente: los gatos de Thondike en la Caja-Problema

RESUMEN

Animal Intelligence: An Experimental Study of the Associative Process in Animals de E. L. Thorndike supuso una significativa contribución a la Psicología del siglo XX. En los manuales el texto se atribuye a Thorndike, sin matices precisiones. El diseño parece simple y convincente: por ensayo y error los gatos aprenden a escapar de una caja-problema. Sin embargo, un examen detenido revela múltiples controles, innovaciones estadísticas y una fuerte interpretación teórica. Esta sofisticación plantea algunas cuestiones: ¿realizó un joven estudiante de postgrado este complejo experimento? ¿por qué se financió este costoso experimento? ¿se ha tornado lo convencional en un mito? Este artículo profundiza en la compleja relación entre el proyecto funcionalista de James, el de los tests mentales de Cattell y la psicología comparada de Morgan y Romanes, para concluir que el experimento de Thorndike fue el medio necesario para dotar al funcionalismo de un experimento fundacional y consagrar la curva del aprendizaje como el método de esta perspectiva científica.

Acknowledgments: Dr. Gerald S. Argetsinger, Dr. Dennis Brooks, Dr. Mary M. Beck, Professor and Department Head, Poultry Science, Mississippi State University, Dr. Gabriel Ruiz Ortiz and Dr. Natividad Sánchez, Linda London, Luthier, and the Spanish Society for the History of Psychology.

Correspondencia David O. Clark: davidoclark7@gmail.com

ISSN: 2445-0928 DOI: <https://doi.org/10.5093/rhp2019a15>

© 2019 Sociedad Española de Historia de la Psicología (SEHP)

To cite this article/Para citar este artículo:

Clark, D.O. (2019). Comparative Psychology and the Objectification of Mind: Thorndike's Cats in the Puzzle-Box. *Revista de Historia de la Psicología*, 40(4), 2-10

Link to this article/Vínculo al artículo:

DOI: <https://doi.org/10.5093/rhp2019a15>

"Animal Intelligence: An Experimental Study of the Associative Processes in Animals" by Edward L. Thorndike was published in June of 1898. Thorndike's stated purpose was to study mental life down through the phylum of organisms in order to find the origins of human mental faculties. His method was the analysis of intelligent behavior in cats, behavior observed as learned responses to problems presented by the environment. Now, over one hundred years later, the experiment is a landmark in the history of psychology.

In this paper, I will approach this crucial episode in the history of psychology from a perspective outlined by Peter Gay (1976) in his essay, *Art and Act: On Causes in History*, in which Gay describes a personological approach to cultural history. One example of this approach is John Demos' (1982) "Entertaining Satan: Witchcraft and the Culture of Early New England," a work in which Demos applies the human sciences to structure his investigation. The preliminary hypothesis for a history of Thorndike's experiment began with the question: With the memorable image of cats learning to escape from puzzle-boxes, at first blush the experiment is simple. But in reality, it is very complicated. Is it believable that a student of Thorndike's age and experience was capable of this experimental sophistication?

At the time Thorndike did this experiment, he was only 23; he had completed two years study in psychology. Peter Gay commenting on the scientific imagination wrote:

"... this kind of intuition requires training, for without that the scientist cannot subject his guesses to adequate tests or fit them into existing bodies of theory. The amateur will not see what the experienced researcher sees, and even if he were to see it by chance, he would not know what to do with it. Scientific vision is nine-tenths experience" (1976, p. 179)

I asked, was there more to Thorndike's story? To place this experiment in the ethos of the emerging experimental psychology: In the 1890s, Psychology was very different from what we know now. Following the scientific discoveries of the 18th and 19th century, there was a profound change in the understanding of human nature. Psychology promised the science of mind, but science required a public object, and the mind proved notoriously invisible. This experiment played an important role in making mind visible.

The Empiricists developed the blank-slate theory of mind. Experience created impressions on the mind, and by the process of association, sensations became ideas. Then the association of ideas was revised to account for evolutionary theory, and mental processes made associations between the environment and responses necessary for survival. In this way, adjustment became symbolic, giving substance and objectivity to mind.

In Germany, the New Psychology, represented by Wilhelm Wundt, synthesized physics and biology into psychophysics to analyze the mental association processes by introspection. In the relationship between mind and body, Descartes was among the first to speculate that stimulation from the environment was transmitted from the senses along the nerves to the mind's sensorium, where the sensations collect for processing. Through stimulation from the environment, after mental processing the individual responded intelligently. The emerging sciences of physics and neural anatomy began to explain

how the environment was conducted to the brain. Golgi and Ramon y Cajal illustrated brain neuroanatomy with the silver-nitrate staining. Helmholtz calculated the velocity of neural impulses. The sensorium was replaced by brain localization.

Consciousness, important for the method of introspection, denotes 'to know with and by myself.' The reliability of this subjective source of knowledge was questioned. William James said,

"... the most important step forward that has occurred in psychology since I have been a student ... is the discovery, first made in 1886, ... there is not only the consciousness of the ordinary field...but an addition thereto in the shape of a set of memories, thoughts, and feelings which are extra-marginal and outside the primary consciousness ..." (James, 1902, p. 256)

Because of the unreliability of subjective experience, psychologists correlated the individual's results with others. That was the beginning of comparative psychology. Evolutionary theory also justified a psychological comparison with animals, other vertebrates with cerebral hemispheres and sensory-centers.

Important for understanding Thorndike's experiment is the analogy argument. The analogy argument for mind is: Immediate conscious experience of the mind is subjective, not public. But, because people experience mental states along with their behavior, it follows that when they see other people, or animals, doing recognized behaviors, similar mental states can be inferred. Unfortunately, confirmation is complicated because the observed behavior could be due to knee-jerk reflexes or instincts. Although reflexes and instincts are all one with mind, of special interest is intelligence.

Intelligence is represented by behavior resulting from mental processes functioning to solve problems that arise in a changing environment. These adjustment processes are considered the evolutionary precursor to thinking, and they are considered the primitive elements of mind necessary to make psychology an experimental science. Through the study of adjustment to the environment, the laws of association will be discovered. In this context, Thorndike's iconic experiment played a role in making mind an observable object.

The goal of this history is to understand the origins, the making, and the meaning of this experiment. This history unfolds in 3 segments following Thorndike's development as a psychologist and the experiment's evolution: The student's laboratory experiment, the pilot studies at Harvard, and the famous experiment conducted at Columbia University. The first problem that presents is how to approach it. How is it to be named? Is it 'The Experiment,' or is it 'The Famous Experiment,' or is it 'Thorndike's Experiment?' These referents denote different stages of development and different points of view. "The Experiment" and "The Famous Experiment" suggests that others also deserve credit. "Thorndike's Experiment" emphasizes conventional wisdom, and gives ownership to Thorndike.

The Harvard Psychology Laboratory 1895

In the fall of 1895, Thorndike entered Harvard as an English major come from Wesleyan University for a Masters degree. This history of the Famous Experiment begins when 21 year old undergraduate

in English Literature decided to take a psychology class because he recognized the professor's name from a book he read the previous year. In doing so, he unknowingly stumbled into William James's ideal education for a professional psychologist. James's plan for budding psychologists included "a good deal" of experimental work. This history of young Thorndike's career as an experimental psychologist begins with his first experiment in the Harvard psychology laboratory in 1895-96.

The records show that in the fall of 1895, Thorndike registered for 3 English courses, a philosophy course, and James's Psychology Seminar, Philosophy 2A (Clifford, 1968, p. 86). In his autobiography Thorndike recalled, "I have no memory of having heard or seen the word psychology until my junior year at Wesleyan University (1893-94), when I took a required course in it. The textbook, Sully's "Psychology", aroused no notable interest, nor did the excellent lectures of Professor A. C. Armstrong,...", Thorndike remembered he read chapters from James's recently published *The Principles of Psychology* at Wesleyan and at Harvard, in the fall of 1895, he "eagerly" registered for Psychology 2A because it was taught by James (Murchison, 1961, p. 263).

Excuse the polite conventions of his memoir, Thorndike made this statement near the end of his illustrious career. Writing for posterity, he knew the experiment was important and his reader wanted the details. The idea for a history of psychology in autobiographies occurred in 1928. The invitation to authors included, "... those individuals who have greatly influenced contemporary psychology..." (Murchinson, 1961, p. ix). In contrast to the legacy statement of an esteemed psychologist, this current history is the factual reconstruction of an experiment carried out in 1897 by a 23-year-old graduate student who recently transitioned from English Literature to Psychology. It begins with James's remarkable Psychology Seminar, Philosophy 2A.

In the fall of 1895, Thorndike attended James's class two days a week. Thorndike's life changing experience in 1895-96 can be inferred from James's correspondence (Skrupskelis & Berkeley, 2000). On 22 October 1895, James informed President Eliot about his Psychological Seminar. This letter indicates that Thorndike was one of nineteen students, and the class did a good deal of experimental work in connection with the seminar. After his fall course was finished, on 8 January 1896, James picked up a pencil to inform Hugo Münsterberg (1863-1916) about the outcome. James advised Münsterberg of his plan for a professional, those with professional goals, they should enter the seminar with the laboratory. James said that: 'The half-year course to succeed Philosophy 1 should be Physiological Psychology, its theoretical part should be by thesis, and a good deal of time should go to laboratory work.' (Skrupskelis & Berkeley, 2000, p. 116). After finishing 2A, Thorndike followed James's plan and continued on to take the Spring, 1896 courses, the 2nd half of the Psychology Seminar and Physiological Psychology (Clifford, 1968, p. 86). Taking these classes, Thorndike fulfilled James's ideal for a professional psychologist. The details of Thorndike's education in experimental psychology are recorded in James's correspondence.

While preparing for the spring seminar, on 8 January 1896, James wrote Münsterberg that Edgar Singer Jr. (1874-1954) was planning the laboratory exercises for winter-spring Philosophy 2B. Again, on 31 January 1896, James wrote Münsterberg that he thoroughly believed

in Philosophy 2B, and with Singer's help he intended to make it "a very instructive course." James added a post script important for understanding Thorndike's development as a psychologist: "Lloyd Morgan the comparative physiologist is here, and Royce is doing him honor of a dinner & reception tomorrow night (1 February, 1896)." (Skrupskelis & Berkeley, 2000, p. 131).

Morgan's explanation of the animal mind plays an important role in Thorndike's Famous Experiment. Visiting from England, Conway Lloyd Morgan (1852-1936) was in Boston on 19 January 1896 giving a series of lectures before the Lowell institute on "*Habit and Instinct in Animals*." On 27 January 1896, Morgan gave a lecture at Harvard on "*The Flight of Birds*." The content was the comparative physiology of wings and a lecture on the instinct of flight (The Harvard Crimson, 28 January 1896). On 21 January 1896, James wrote to invite Morgan to board at his house, promising Morgan lunches and breakfasts good for philosophical conversation (Skrupskelis & Berkeley, 2000 p. 577).

In the spring, in a letter to Münsterberg on 23 April 1896, with high praise for Singer, James described Thorndike's undergraduate laboratory.

"Singer has turned out magnificently. ... A small number of men about 20 divided into pairs, each pair dealing in succession with some rather definite and numerical little experimental problem illustrative of a fundamental psychophysic method: none of them going over a whole course of demonstrations, but public reports, with discussion being made every three weeks or so by the entire set, of their several work, and Singer giving a weekly lecture or two to keep things together. ... The men are a picked lot, all the weaker ones having dropt-off, and their moral was excellent. The definite invention of problems, apparatus, etc by Singer is worthy of all praise. I could have done nothing near so good, and it seems to me the perfection of a course, granting such men. Of course each of Singer's men has also a thesis of which I have charge." (Skrupskelis & Berkeley, 2000, p. 144).

James's lecture notes also provide insight into Thorndike's thesis. Based on James's notes (James, 1988, p. 212), the classroom instruction was basically epistemology, the philosophy of science. The discussions, concerned the nature of data, data was approached from the subjective and objective points of view. Thorndike was assigned to read Shadworth Hodgson (1832-1912), a British philosopher who foreshadowed pragmatism. In his margin notes, James describes Thorndike's undergraduate thesis: "The 'whole' tho't world is identical with the whole real world - Thorndike's thesis / Cf. Hegel." (James, 1988, p. 219). As is well known, Cf. is Latin, and it means compare (similarity) with the topic being discussed. The mnemonic heuristic for Hegel is: 'What is real is rational: what is rational is real.' This Rationalist point of view conflicted with James's vision for experimental psychology. Was James suggesting that Thorndike had expressed faith in the human mind to comprehend the real? James's position was, "On my pluralistic scheme, the oneness of the universe comes from the parts overlapping..." (James, 1988, p. 224). This class-content contributed significantly to Thorndike's future as an experimental psychologist.

Meanwhile, there is Thorndike's laboratory training, it may account for his transformation. In his legacy memoir, Thorndike included the laboratory, "During the 2nd half of 1895-1896, Mr. Hackett and I made experiments in a course under the direction of Professor Delabarre, who had charge of the laboratory" (Murchison, 1961, p. 264). This statement is important because it was often quoted in psychology textbooks. In fact, Thorndike was mistaken, and a mistake of this magnitude suggests cause for concern. Thorndike was supervised by Singer. Memory-lapse can be attributed to the unconscious factors. From James's account, the morale in the laboratory was high. It is a principle of human nature that something emotionally stirring must have contributed to Thorndike's metamorphosis from English Literature student into an experimental psychologist. The laboratory may have been the incubator of Thorndike's transformation. It was extraordinary that Thorndike would forget who introduced him to experimental practices.

As evidence for his real experience, Thorndike's name appeared in the *Psychological Review*, in "Contributions from the Harvard Psychological Laboratory: Discrimination in cutaneous sensations: Studies in sensation and judgment" (Solomons, Singer, & James, 1897). His name appeared in section two, titled "Studies in Sensations and Judgment." A footnote by Singer on page 250 reads, "This and the following studies are the partial outcome of a course given to the undergraduates of Harvard University during the Winter and Spring of 1896."

In his introduction to the class experiments, Singer wrote, "A group of coordinated experiments was conducted with the view of determining how far the process of differentiating the physiological bases of sensation could be carried. These included the sensory fields of touch, pain, temperature, taste and sight. ." (Solomons, Singer & James, 1897, p. 250). Thorndike's laboratory class replicated psychophysics experiments. Thorndike's name appeared on page 270, where his experiment was described as:

"Series including differences in form, color and size of figures. This series, carried out by Messrs. Hackett and Thorndike, required somewhat special apparatus. Figures of more or less complex shape were drawn on cards. The figures were either exactly alike, or differed in size, shape, color, or any combination of these. It would have been difficult to make the differences sufficiently slight to have yielded a considerable percentage of wrong judgments...." (*ibid.*, p. 270)

This shows the level of sophistication that Thorndike was trained to. These experiments required apparatus and emphasized attention to detail in the manipulation. Perhaps most importantly, pointing to the importance of statistics Thorndike replicated experiments by George S. Fullerton (1859 -1925) and James Cattell (1860-1944). The historian Edwin Boring (1886 -1968) comments on the experiments Thorndike replicated, "The most important outcome of this period was his (Cattell's) monograph *On the Perception of Small Differences* (1892). This showed Cattell bringing statistical method to bear upon the conventional procedures in psychophysics. In this research, Cattell and Fullerton introduced the functional point of view into psychophysics." (Boring, 1957, p. 534)

In his conclusion, Singer discussed the lessons taken from their experiments:

"The main standpoint of the early psycho-physicists ... the assumption that when two stimuli were presented there was only one sense in which they differed, ... Some, like Fullerton and Cattell, would be willing to say that there is no difference so slight but that in some sense it was noticed ... our own researches we feel justified in going a step further. ... a difference may be noticeable or not according to what we may mean by 'difference.' ... a specific kind of difference may be noticeable or not, according to purely mental preparedness of the subject to receive it. With these facts recognized, the problem of psycho-physics awaits a re-statement." (Solomons, Singer, & James, 1897, p. 271)

The significant phrase is "psycho-physics awaits re-statement." It is important to note that although Singer was the laboratory supervisor, James was the director. The laboratory was systematically picking Wundt's psychophysics apart by challenging its experiments. This is consistent with James revision for psychology as an experimental science, and it is the context in which Thorndike is being trained as an experimental psychologist.

Now it is time for a summary of Thorndike's first year at Harvard: From a footnote on page 87 of *The Sane Positivist*, Thorndike's transformation may be inferred from his grades. In English his grades were uncharacteristically mediocre: English 1, B+; English 14, C+; English 23, B. In psychology he received an A-. In James' psychology, ... A's in both the two spring courses. (Records of the Class of 1896, Harvard University, Clifford, 1984). Clifford noted that Thorndike's grades in English grades were uncharacteristic of his ambitious nature. In his legacy memoir, Thorndike remembered, "Work in English was dropped in favor of psychology in the course of the first graduate year, and by the Fall of 1897, I thought of myself as a student of psychology and a candidate for the PhD degree" (Murchison, 1961, p. 264). Again, Thorndike's memoir is misleading. The evidence points to his undergraduate year at Harvard as his turning point. Thorndike began 1895-96 an English major, and in Psychology he emerged as one of nineteen students who impressed James so much that he took Thorndike on as his graduate student.

William James's Basement

In the fall of 1896, Thorndike entered Harvard's graduate program. In his application for a graduate school scholarship in 1896-97, he said he is intent on becoming a psychology professor. His stated goal was to receive a Harvard PhD in 1899 (Thorndike papers, Harvard Archives).

Again, Thorndike's memoir misrepresents the facts. After supervising Thorndike's first laboratory class, Singer returned to the University of Pennsylvania, and James hired Edmund Delabarre (1863-1945) to replace him. Thorndike's memory-lapse may refer to another event that occurred in Delabarre's laboratory in the fall 1896. Thorndike recalled, "During 1896-1897 I first attempted to measure the responsiveness of young children (3-6) to facial expressions or

movements made unconsciously as in mind-reading experiments.... But the authorities ... would not permit me to continue ... I then suggested experiments with the instinctive and intelligent behavior of animals..." (Murchison, 1936, p. 264). Also interesting for understanding the origins of the Famous Experiment, Thorndike stated, "The motive for my first investigations of animal intelligence was chiefly to satisfy requirements for courses and degrees. Any other topic would probably have served me as well. I certainly had no special interest in animals and had never taken a course in biology..." (Murchison, 1936, p. 265).

Was it the case that young Thorndike, finding himself at the beginning of a graduate program, felt the urgent need for a thesis topic to please James? Did the idea for an animal experiment occur when he was groping for an acceptable thesis? If so, Fortune played a much larger role than usually acknowledged. But for an administrative decision to spare children from the possible trauma of a psychology experiment, American psychology may have turned out differently.

Thorndike's graduate year proved important for understanding the origin of The Experiment. Unfortunately, if a copy of Thorndike's masters thesis exists, it remains undiscovered. Many clues to the events of Thorndike's graduate year at Harvard are found in his legacy memoir, in the record of his first year's studies, and published in the Famous Experiment the following year. At the start of his graduate year, Thorndike needed an experiment.

From Thorndike's autobiography, "... (I) conducted experiments in my room until the landlady's protests were imperative. James tried to get a few square feet required for me in the (psychology?) laboratory, and then in the Agassiz Museum. He was refused, and with his habitual kindness and devotion to underdogs and eccentric aspects of science, harbored my chickens in the cellar of his own home for the rest of the year" (Murchison, 1961, p. 264-65). In fact, Thorndike also carried out animal experiments at Harvard, and that is documented as a footnote in the Famous Experiment. The questions that arise are: Why in James's cellar?

Thorndike needed a thesis, and in his memoir he said that he was flexible. James undoubtedly had many choices available to him. Any other thesis would have been much less disruptive. James could have suggested Thorndike replicate a psycho-physics experiment in Delabarre's laboratory. However, enthusiasm for New Psychology was low. As director of the psychology laboratory, James could have ordered Delabarre to make room for Thorndike. Instead, James chose to inconvenience his family by bringing a graduate student with chickens into his house for several months. That is interesting because there were much easier options available.

Thorndike attributed James's hospitality to kindness. Kindness may have contributed; however, events are usually over-determined. In light of the trouble James went to, an alternative explanation suggested is: Did James have a special interest in this experiment? Did James, in some oblique way, suggest the experiment? In the context of the related facts, it is doubtful that James was indifferent. And in light of the usual relationship between a graduate student and supervisor, it is reasonable to ask, How much did James contribute? Neither, it cannot be overlooked that Thorndike's supervisor was not just any professor! By now, it must be assumed that James played a much bigger role in the history of the Famous Experiment than previously acknowledged.

The confluence of concurrent events suggest that Thorndike began experiments with chicks in James's basement by replicating Morgan's experiments found in *An Introduction to Comparative Psychology*. Evidence linking the basement experiments to the Famous Experiment is found in Thorndike's footnote on page 8 of "Animal Intelligence: An Experimental Study of the Associative Processes in Animals."

"The experiments now to be described were for the most part made in the Psychology Laboratory of Columbia University during the year '97-98,' but a few of them were made in connection with a general preliminary investigation of animal psychology undertaken at Harvard University in the previous year" (Thorndike, 1898, p. 8).

Thorndike's pilot studies for The Experiment were carried out in James's house. From Thorndike's memoir, after he was denied the use of children as subjects, "... I then suggested experiments with the instinctive and intelligent behavior of chickens as a topic, and this was accepted" (Murchison, 1961, p. 264). Where did that idea come from? The phrase, 'instinct and intelligence' combined with the use of 'chicks' for his subjects points to Morgan.

Morgan entered this history a few short months before, while Thorndike was undergoing a remarkable one-year metamorphosis into an experimental psychologist. In January of 1896, Morgan lectured at Harvard and boarded with James. In fact, the two men had a lot in common. Morgan's understanding of mind was very similar to James's. Both men were influenced by Herbert Spencer's (1820-1902) theory of mental evolution and the function of mind in the service of survival. Whatever the two men talked about during that visit, soon after, Thorndike was doing experiments very similar to Morgan's in James's basement. For example, Morgan's two most interesting experiments in terms of Thorndike's Experiment were the 'chick and the cinnabar caterpillar' and 'Blackie's Escape.'

Why use chickens for a psychology experiment to study instincts and intelligence? Important for comparative psychology, the chicken is similar to the human because it is a vertebrate, the brains of birds and mammals are similar, and the chicken has sensory centers. The behavior of the chicken results from a complex coordination between body movement and its environment. But, the chicken is different from humans in an important way too. The chicken does not require the nurturing that a mammal requires. After fertilization, the embryo develops in the egg. After 21 days of incubation, the chick breaks through the eggshell and begins to explore. Because it comes from the egg ready to act and without prior experience, it comes closer to being the ideal naïve subject to sort-out reflexes from instincts and instincts from learning. The experiment gives the psychologist the means to isolate learned behavior, and that is necessary to analyze the processes of learning associations. For example, perhaps one of Morgan's most demonstrative experiments, undoubtedly known by Thorndike, was the "chicks and the cinnabar caterpillar."

The cinnabar moth feeds on ragwort, an alkaloid based plant, and it is commonly known that its caterpillar is unpalatable to birds. The caterpillar is striped with bold colors that warn predators. Morgan introduced four-day-old chicks to a small worm and a cinnabar caterpillar. He observed that after pecking the chicks rejected the cinnabar, but they ate the worm. Morgan concluded that initial

pecking of the cinnabar proved the absence of instinctive knowledge of a difference between the caterpillar and the worm. Also, the chicks demonstrated profiting by experience when they discriminated between the caterpillar and worm by sight. He concluded that they made associations between the cinnabar and its unpleasant outcome, and the worm with its pleasant outcome. The chicks experience provided guidance for future action. Learning was also evident due to the chicks ability to inhibit the otherwise instinctive motor responses of pecking (see Morgan, 1894 pp. 214-15)

More noteworthy for the Famous Experiment, Morgan included Blackie's Escape. Morgan corralled his chicks with newspaper. One day he observed: "... Blackie, a week old chick, Pecking at a number on the newspaper, bending the paper down, making a breach in the wall." Blackie escaped, and when Morgan returned Blackie to the enclosure, the chick repeatedly returned to the spot where he escaped. Morgan concluded, "Unquestionably this is a more complex case of intelligence than that which I gave before" (Morgan, 1894, p. 216).

Given the proximity in time and space of Morgan, Thorndike, chicks and James's house, it seems reasonable to assume that important influences were mixing. However, Morgan presented Thorndike with a problem. Blackie pointed to intelligent behavior, but what would be a good a design for a Harvard trained experimental psychologist? Thorndike's training emphasized apparatus and statistical methods. The English methods used by Morgan emphasized natural history observation and the single subject design. The following from Thorndike's experiment may suggest how the Famous Experiment was developed in James's house from Blackie's Escape:

"... there are, in the records of my preliminary study of animal intelligence (conducted in James's house), a multitude of all sorts of associations which some chicks have happened to form. Chicks have escaped from confinement by stepping on a little platform in the back of the box, by jumping up and pulling a string like that in D, by pecking at a door, by climbing up a spiral staircase and out through a hole in the wall, by doing this and then in addition walking across a ladder for a foot to another wall from which they could jump down, etc., etc." (Thorndike, 1898, p. 36)

Perhaps inspired by Blackie's Escape, Thorndike developed mazes to observe animal intelligence; the evidence of the mental processes was observable in the escape from confinement. This was similar to Morgan's observation of Blackie, but Thorndike's pilot studies for the Famous Experiment included another development. Thorndike timed the escape. The following describes the method that may have been developed in James's house. From the Famous Experiment:

"The formation of each association may be represented graphically by a time-curve. In these curves, lengths of one millimeter along the abscissa represent successive experiences in the box, and heights of one millimeter above it, each represent ten seconds of time. The curve is formed by joining the tops of perpendicular erected along the abscissa 1 mm. apart (the first perpendicular coinciding with the y line), ... we may take the general slope of the curve as representing

very fairly the progress of the association." (Thorndike, 1898, pp. 15- 16)

To be more succinct, Thorndike timed the escape. He subjected the same animal to repeated trials. He plotted these times around an X-Y axis. The vertical Y-axis represented time to escape, the horizontal X-axis represented the number of trials. As the chick practiced and perfected the escape, the plotted times resulted in a curved line. The line began high near the Y-axis and then swooped down into a curve descending outward along X-axis. The line stopped when it was obvious that the animal had learned the escape. White (1987, p. 83) provides some insight into the experimental mind-set for data collection, "Experimentalists have always been... seduced by whatever they call objective. Sometimes this has meant no more than that information has been put down on paper."

In the end, the chicken experiment worked well for him, Thorndike got his Masters. On 10 March 1897, Thorndike submitted a request for a graduate school fellowship. He said he wanted to remain at Harvard for two or more years. His goal was to receive a PhD in psychology in 1899 (Thorndike papers, Harvard Archives). Harvard accepted his request along with a scholarship of \$150 and with \$200 from the Price Greenleaf Fund (Cliffor, 1985, p. 99). And then, amazingly soon after, on 23 April 1897, Thorndike contradicted himself, and told Harvard that he accepted a fellowship at Columbia University (Thorndike papers, Harvard Archives). What happened?

In his legacy statement, Thorndike said it was for money: "During the two years of study at Harvard, I supported myself as a tutor... A year free from such labor seemed desirable, so I applied for a fellowship at Columbia. I received the appointment, and upon inquiry was informed by Professor Cattell that an extension of my work on the mental life of animals would be suitable for a doctor's thesis" (Murchison, 1961, p. 264). However, Thorndike's memoir has been unreliable before.

For an alternative explanation, Clifford cited Thorndike's correspondence with Elizabeth Mouton to make the case for unrequited love. Thorndike wrote to Mouton, "I got the Columbia thing and accepted it today. Don't think you made me do it when I didn't want to. I think it best in every way" (Cliffor, 1984, p. 103). Undeniably, money and women are among the plausible explanations for a young man's choices. But what ambitious graduate student would trade a bird-in-hand, paid-for PhD, supervised by William James, at Harvard University, for uncertainty in the bushes at Columbia? Thorndike's memoir also implied that he applied to only one university and then days later received a fellowship that came with \$700, at a time when the industrial wage was 15 cents an hour, and the U.S. was in the 5th year of an economic depression (Cliffor, 1984, p. 104). Was that merely due to luck? There are two other principles that must be considered in his move from Harvard to Columbia, James and Cattell.

Cattell founded the Psychology Department at Columbia. His interests were individual differences. It must be asked, why did Cattell, for no obvious reason, decide to gamble on a 22 year old novice with an animal experiment? Moreover, why did Cattell allocate a significant amount of his budget, laboratory space, and a menagerie? Furthermore, as the owner-editor of *The Psychological Review*, why would Cattell risk antagonizing James by taking his graduate student.

Indeed, it is hard to believe that Cattell would have taken Thorndike without James's recommendation. This raises the question, How extensive was James's role this change of venue?

Many questionable explanations and unanswered questions arise regarding Thorndike's move from Harvard to Columbia. Considering the sociology of institutional science, three people with complex motives are involved in Thorndike's move. Although Thorndike was ambitious, he wanted a PhD, but a student's future is not entirely in his own hands. To follow Occam's Razor, this analysis will proceed with the parsimonious assumption that for reasons of their own, James and Cattell decided to do The Experiment at Columbia.

Cats in the Puzzle-Box: The Famous Experiment

The experiment, "Animal Intelligence: An Experimental Study of the Associative Processes in Animals" by Edward L. Thorndike A.M., University Fellow in Psychology, Columbia University was accepted as Thorndike's dissertation, and to attest to its importance, Cattell, the editor of *The Psychological Review*, published it as a monograph.

In his introduction, Thorndike's justification for the animal experiment was to study mental life down through the phylum of organisms to find the origins of human mental faculties. This was to be accomplished by the study of associative processes. In the associative process, was the origin of the human mind (see Thorndike, 1898, pp. 2-3).

To accomplish this, Thorndike used the following design:

"I chose for my general method ... merely to put animals when hungry in enclosures from which they could escape by some simple act, such as pulling a loop of cord, pressing a lever, or stepping on a platform.... The animal was put in the enclosure, food was left outside in sight,... a record was kept of the time that he was in the box before performing the successful pull, or clawing, or bite. This was repeated until the animal had formed a perfect association between the sense-impression of the interior of the box and ... the successful movement." (Thorndike, 1898, p. 6).

Although several animals were included (chicks, dogs, and cats), the experiment emphasized cats. What happened to the chickens? Perhaps the change occurred because universities were accustomed to cats. It was traditional to use cats to instruct anatomy, physiology, and to train medical students. Much is known about cats that can be correlated with their behavior. The cat possibly contributed because it was more anthropomorphic than the chick. The cat possibly contributed mammal-credibility. Their rhetorical value may have been a factor. Whatever the reason was, it was a good decision because the cats made the experiment memorable for generations of future psychologists.

Thorndike's Experiment, on page 58:

"My cats were kept in a large box about 4 feet high, the front of which was covered with poultry-yard netting. Its top was a board, which could be removed. To save opening the door and letting them all loose, I was in the habit of taking them out of the top when I wanted to experiment with them." (*ibid.* p. 58).

Based on the ages of the cats found on page 12 of the experiment, a best guess is, the majority of manipulations and observations in this experiment occurred over a period of approximately two months. In brief, Thorndike observed approximately 13 kittens, ages 3 to 11 months old, including one outlier 18-19. He observed them escaping from crudely fabricated wooden cages, measuring approximately 20" long (50 cm), 15" wide (38 cm), and 12" high (30.5 cm) (Thorndike, 1898, p. 8). The escape-times obtained from each kitten were plotted on an X-Y axis, the resulting graph was the kitten's learning-curve. In addition to the experiments, a major portion of the monograph was devoted to interpreting the results in terms of associative learning.

To fully understand Thorndike's interpretation, the reader should be familiar with *Animal Intelligence* by Romanes and *An Introduction to Comparative Psychology* by Morgan. In general, Thorndike's mode of argument was not unlike the one James often used in *The Principles*. Where James reacted against Wundt, Thorndike reacted against Romanes and Morgan. Thorndike began with the question: Are animals ever led to any of their acts by reasoning? He emphatically stated that he would answer this question, "once and for all." And to eliminate all possible criticism of his results, Thorndike's experimental matrix incorporated a complex number of controls.

He began, "The first great question is whether or not animals are ever led to do any of their acts by reasoning" (Thorndike, 1898, p. 39). Based on observing kittens escape from a puzzle-box, Thorndike claimed there was no evidence of reasoning. Next, Do animals learn by imitating? Are the roots of this human characteristic found in animals? Thorndike controlled for this by having animals watch others escape, and he said that he found no evidence for imitative learning. Next, Do animals form associations by similarity and do they form concepts? Do they have ideas that can stimulate intelligent acts? Again, Thorndike found no evidence. They responded to environmental cues. Next, Do animals have delicacy of association (can they discriminate)? This was undisputed. Thorndike (p. 91), "Chicks from 10 to 25 days old learned to go directly a sort of big labyrinth requiring a series of 23 distinct and in some cases fairly difficult associations, of which 11 involved choices between two paths." However, he cautioned that this demonstrated number and not complexity. Next, How many associations could animals master? Next, How permanent were the associations? And he also included, inhibition of instincts by habit, attention, and social interaction. It was an ambitious interpretation of animal intelligence based on one design and dependent upon adolescent cats.

He concluded, "The first great question is whether or not animals are ever led to do any of their acts by reasoning. Do they ever conclude from inference that a certain act will produce a certain desired result? The best opinion is that they do not." (p. 39) Thorndike challenged his reader (p. 31), "Surely every one must agree that no man now has a right to advance theories about what is in animal's minds or to deny previous theories unless he supports his thesis by systematic and extended experiments."

This caught the imagination of many psychologists, and over the years it has achieved mythic status. In the end, the memorable feature was the cat escaping from the puzzle-box, and the puzzle-box became symbolic for Trial and Error learning and Thorndike's Law of Effect, but those attributes were added after the fact.

Concluding Remarks

With the publication of Thorndike's Experiment, this investigation comes to a close. It is time for a conclusion. The current understanding of Thorndike's Experiment has evolved from a few primary sources. Then some elements from his long career were added in retrospect. In conventional wisdom, the story of Thorndike's Experiment has become legend in the history of psychology.

Here, precepts inspired by Peter Gay and John Demos were followed. The event was placed in its social context. The facts suggested by the hypothesis were extracted from the relevant primary and secondary sources. These were evaluated for reliability. Thorndike's memoir suggested paths that were explored, but some important details have been shown to be false. The confirmed events were chronologically ordered, and plausible connections drawn between the facts. What does it all mean?

To begin, it would seem natural to place Thorndike's Experiment in the context of his illustrious career. But this is not a celebration of the esteemed pioneer of American Psychology. This is the history of an experiment conducted by a young graduate student. Given the conventional wisdom, and the experiment's status as a psychology icon, it is expedient to clear up misconceptions. The foremost error that evolved over time was the myth that Thorndike discovered Trial and Error learning. He did not. Thorndike borrowed Trial and Error learning from *An Introduction to Comparative Psychology* published in 1894. And he did little to improve it (see Morgan, 1894, p. 214). Secondly, it is a mistake to think of Trial and Error learning as the important fact. It is not. Thorndike borrowed the Trial and Error theory as an interpretive instrument to explain the observed facts, animals learning to escape from boxes. Finally, the "Law of Effect" never appeared in the famous Thorndike Experiment.

His title suggests Thorndike's mind set, "Animal Intelligence: An Experimental Study of the Associative Processes in Animals." Thorndike signals to the psychology community by alluding to Romanes, *Animal Intelligence*, and he implies Morgan's work was not scientific. Thorndike is announcing that "Animals do not think, and here is my experimental proof. I am scientific, where Romanes and Morgan were not." In fact, Thorndike's aggression was unjustified. Romanes and Morgan are noteworthy scholars that paved the way for this experiment. Explaining this kind of aggression, Boring commented on William James:

"... James hated sham and that there was a very considerable amount of false scientification in this period ... James called Fechner's law "an idol of the den" because the respect shown it in both attack and defense was out of all proportion to the validating evidence for it. ... James was right about these idols, but, being so close to them, he failed to see what use it is that idols have.... The point here is ... psychology was not ... a discovery, but a movement.... James's day was insecure, self-conscious, and full of the business of founding itself. It exaggerated the immediate importance of its tools and methods, and, in a way, it had to, because that is the state of mind of a new science. It was aggressive, and the aggression got into the experiments and into the publications (Boring, 1957, p.197).

Next, there were many problems with this experiment, the most obvious was inferential thinking cannot be tested in a puzzle-box. The design eliminates inference; the only option is trial and error. One criticism might be: 'This experiment was gladly received by those who were already convinced, but it did little to persuade those who were not.' Thorndike demonstrated that cats could be trained to escape from a box, but that was nothing new. Although the conventional wisdom credits Thorndike, after reviewing the facts one must conclude that James and Cattell share responsibility for the experiment. Previously unacknowledged, it was in fact "Their Experiment" too. With its empirical faults exposed, why did they authorize it?

Competent researchers do not do experiments until they know what the outcome will be. That is what pilot studies are for. The sociology of science demands accountability for the institution's reputation and resources. James risked domestic tranquility, Cattell invested the resources of Columbia University. People like them do not waste time on trivial demonstrations or waste money publishing what people already know.

The clue to its true meaning is found in Thorndike's conclusion, on page 108. It is a word buried in a sentence, and ignored in the legend: "If the reader cares here, at the end, to have the broadest possible statement of our conclusions and will take the pains to supply the right meaning, we might say that our work has described a method..." Here, "method" was a synonym for the Learning-Curve! Unnoticed today, in 1898 the learning-curve would have seemed to psychologists like the invention of the X-ray did to doctors. Rather than an experiment of discovery, think of Thorndike's Experiment as a demonstration of the learning-curve. The learning-curve was a positive contribution towards making the invisible mind an observable object. So, how did this experiment contribute towards making psychology an experimental science?

For Cattell's return on his investment: Boring wrote, after reminding his reader that Cattell's interest was in mental tests,

"E. L. Thorndike was his student. After devising mental tests for animals in the form of the puzzle-box of his doctoral dissertation, he was advised by Cattell to undertake the same sort of thing with children at the new Teachers College founded at Columbia. Thorndike has been the leader in the psychology of mental test in America. Columbia was for years the leading university in this movement. Between them Cattell and Thorndike created at Columbia an irresistible atmosphere, and Cattell, who refused to follow Wundt, could later see his own influence all over America spread by Columbia students – his children, his grandchildren by way of Thorndike, and even his great-grandchildren." (Boring, 1957, p. 539)

As for James's kindness? In *The Principles of Psychology*, James published his vision for psychology. Beginning with homage to Spencer's 1855 *The Principles of Psychology*; he introduced the reader to psychology with the sheep's brain and a frog's escape, and in chapter 20 he concluded that Wundt's theory was the flimsiest thing in the world. James's goal was to make psychology an experimental science. In terms of Kuhn's definition for a scientific paradigm, a paradigm required 4 elements: symbols, values, publications, and experiments (Kuhn, 1962). Applied to James in the 1890s, the symbol

was learning to adjust to the environment, and that objectified mind. His value: James valued experimental science. For publication, he was associated with *The Psychological Review*. But compared to Wundt, James's paradigm did not have an experiment. Not until 1898. With the publication of Thorndike's Experiment, James's finally had his own 'idol of the den.' Although it was not a perfect instance of scientific discovery, it could be replicated. And it promised a method by which to analyze associative learning in order to find the elements of mind and the laws of association. James's paradigm was complete. The stage was set for American functional psychology in the 20th century.

Referencias

- Boring, E. G. (1957). *A History of Experimental Psychology, 2nd Ed.* New York, N.Y.: Appleton-Century-Crofts, INC.
- Clifford, G. J. (1984). *Edward L. Thorndike: The Sane Positivist.* Middletown, CO.: Wesleyan University Press.
- Demos, J. (1982). *Entertaining Satan: Witchcraft and the Culture of Early New England.* New York, N.Y.: Oxford University Press.
- Gay, P (1976). *Art and Act: On Causes in History – Manet, Gropius, Mondrain.* New York, N.Y.: Harper and Row.
- James, W. (1890). *The Principles of Psychology.* New York, N.Y.: Henry Holt & Co.
- James, W. (1902). *The Varieties of Religious Experience.* London & Bombay: Longmans, Green & Co.
- James, W. (1988). *Manuscript Lectures.* Cambridge, MA.: Harvard University Press.
- Kuhn, T. (1962). *The Structure of Scientific Revolutions.* Chicago, Ill.: University of Chicago Press.
- Morgan, C. L. (1894). *An Introduction to Comparative Psychology.* London, UK: Walter Scott, Limited.
- Murchison, C. (1936). *A History of Psychology in Autobiography.* Worcester, MA: Clark University Press.
- Murchison, C. (1961). *A History of Psychology in Autobiography Vol. II.* New York, N.Y.: Russell & Russell.
- Romanes, G. J. (1883) *Animal Intelligence.* New York, N.Y.: D. Appleton & Co.
- Skrupskelis I. K. & Berkeley E. M. (2000). *The Correspondence of William James: 1895-June 1899, Vol. 8.* Charlottesville, VA: University Press of Virginia.
- Solomons, L. M., Singer Jr., E. A., & James, W. (1897). Contributions from the Harvard Psychological Laboratory: Discrimination in cutaneous sensations; Studies in sensations and judgment. *Psychological Review*, 4(3), 246-271.
- Thorndike, E.L. (1897, March, 10) Application for a Fellowship or Scholarsip. Thorndike Papers, Harvard University Archives. Cambridge, Massachusetts.
- Thorndike, E. L. (1898). Animal Intelligence: An Experimental Study of the Associative Process in Animals. *The Psychological Review. Monograph Supplements*, 2(4), 1-109.
- White, R. (1987). *A Memoir: Seeking the Shape of Personality.* Marlborough, NH: The Homestead Press.