FROM CHICK TO CHILD: THE ROLE OF ANALOGY IN THE MAKING OF THORNDIKE’S EDUCATIONAL SCIENCE

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ABSTRACT
In this article, the first to analyze the role of analogy in Edward Thorndike’s educational vision, I argue that the feat of Thorndike’s analogy-making was his ability to launch an experimental science of child learning without having had access to children. That the origin of American pedagogical science rests on Thorndike’s animals stands as a palpable example of the power of analogy to serve a constitutive function in scientific invention. In Thorndike’s case, the social consequences were considerable: His juxtaposition of the child and the animal, his fusing of the two in the concept of the animal-child mind, led him to reason that infants, like animals, were incapable of having ideas, and children, though fully capable, still learned best in many cases through the process of rote memorization and drill.

INTRODUCTION
In the three decades since George Lakoff and Mark Johnson [1] inaugurated the cognitive linguistic turn in studies of discourse, researchers of analogy have contributed prominent features to the emerging scholarly portrait of science in modern times [2-7]. Some have traced the consequences of particular analogies into the technical recesses of scientific activity, emphasizing both interpersonal and intrapersonal dimensions of its epistemic functioning [4, 7-9]. Others have undertaken more expansive commentaries on the nature and evolution of scientific...
analogy itself [10, 11]. No one, however, has examined the role of analogy in the origins of modern educational science.

In this article, I explore the central role of analogical thinking in the earliest and arguably most pioneering work of Edward Thorndike, father of experimental education, founder of educational psychology, one-time paragon of science in America. Thorndike’s 1898 *Animal Intelligence* [12] was as austere as it was bold—the first study to experimentally measure animal learning—his science, more positivist than that of the quantum revolution then cascading over physics and chemistry; his commitment to the celebrated sensory core of the Enlightenment, more pronounced than any other American psychologist’s of the time. And yet even here, in a project aiming to excise all “magical agencies” [12, p. 241] from the study of behavior, analogy can be found operating constitutively, irreducibly, and to considerable social effect. As we will see, the feat of Thorndike’s analogy-making was his ability to launch an experimental science of human pedagogy, a science of teaching and learning for children in the classroom, without having had access to children. That the origin of American pedagogical science rests on Thorndike’s animals stands as a palpable example of the power of analogy to serve a constitutive function in scientific invention. In Thorndike’s case, the social consequences were considerable: His juxtaposition of the child and the animal, his fusing of the two in the concept of the animal-child mind, led him to reason that infants, like animals, were incapable of having ideas, and children, though fully capable, still learned best in many cases through the process of rote memorization and drill.

**BACKGROUND**

Early in the winter of 1898, while the rest of New York talked of the recent consolidation of the five boroughs, and while the bohemians of Greenwich Village fanned the flame of modernism in cafes and theaters across the city, the all-too-Victorian Thorndike set about the task of writing his doctoral dissertation—the first experimental study of animal learning—in a small flat on the Upper West Side. Thorndike had spent two years at Harvard under the inimitable William James, whose *Principles of Psychology* had set in motion his conversion from literature to psychology while he was still an undergraduate at Wesleyan. At Harvard, Thorndike completed his epistemological transformation from the “loving interest of the poet” to the “emotionally indifferent attitude of the scientific observer,” an ethically superior position in his mind but one that would later place him at odds with many of his colleagues in education and the arts [13, p. 61]. Humans became his object of study, children in particular, until 1897 when, for reasons unknown to us, Harvard officials objected to his continued use of children as research subjects. This prompted Thorndike to resort to a research project on “the instinctive and intelligent behavior of chickens” [14, p. 87]. While the leap to chickens may ostensibly seem capricious,
the child, as we will see, was never far behind owing to Thorndike’s judicious use of analogy.

At Columbia the following year, as the *wunderkind* graduate student of James Cattell, Thorndike continued the line of animal research begun at Harvard, his animals now occupying the fifth floor of a university building rather than James’ private cellar. He admitted choosing the topic of animal intelligence not because he “knew animals or cared much for them” but because he “thought [he] could do better than had been done” [14, p. 89]. And what had been done by past scholars was lackluster if not entirely sentimental in his estimation: a body of writing redolent of anecdote and woven from sensational tales designed to praise the marvels of the natural world, achieving if anything an “abnormal or supernormal psychology of animals” rather than the sort of representative accounts befitting men of science [12, p. 25]. “Dogs get lost hundreds of times and no one ever notices it or sends an account of it to a scientific magazine,” wrote Thorndike [12, p. 24], “[b]ut let one find his way from Brooklyn to Yonkers and the fact immediately becomes a circulating anecdote.” Cats fared no better:

Thousands of cats on thousands of occasions sit helplessly yowling, and no one takes thought of it or writes to his friend, the professor; but let one cat claw at the knob of a door supposedly as a signal to be let out, and straightway this cat becomes the representative of the cat-mind in all the books [12, p. 24].

In contrast to the sensationalism he felt encroaching on psychology, Thorndike kept his experiments profoundly simple: “It was merely to put animals when hungry in inclosures from which they could escape by some simple act,” he explained, “such as pulling at a loop or cord, pressing a lever, or stepping on a platform... [F]ood was left outside in sight, and [the animal’s] actions observed” [12, p. 26]. He then measured the time it took each animal—chick, cat, or dog—to escape the box, repeated the procedure until each animal escaped almost immediately, and graphed the results over time (see Figure 1).

**USING ANALOGY TO THEORIZE A MATERIALIST ANIMAL MIND**

To explain anything about the animal mind, Thorndike had to move beyond the descriptive fact that the time each animal spent on task eventually decreased over the course of his experiments (see Figure 1). He had to admit a conceptual foundation for his theorizing, and he did so by drawing an analogy from the modern technology of the day. The animal mind, argued Thorndike, was nothing more than a collection of neurons akin to the wires of a telephone network. These neurons were modified by experience to form useful stimulus-response bonds in much the same way as a switchboard operator modifies a circuit to complete a call. Telephony was an electrical system, Thorndike’s electrochemical,
but the structural features of interest to Thorndike remained consistent as he glided from one to the other domain:

- **CONDUCT** (wires, electrical signals)
- **CONDUCT** (neurons, electrochemical signals)
- **CONNECT** (subscriber\(_1\), subscriber\(_2\))
- **CONNECT** (afferent system, efferent system)
- **MODIFIES** (operator, circuit)
- **MODIFIES** (experience, stimulus-response bond)

Conceptualized this way, the mind was seen as a predictable and passive organ of transmission responsible for routing intact signals between the afferent and efferent systems by way of stimulus-response bonds, themselves a kind of neurochemical coupling capable of switching their configuration in light of experience. The implications for Thorndike’s science were profound: we need nothing as imponderable as purpose or intentionality to account for a cat’s pressing of a lever, a dog’s excitement from the knock at the door, reasoned Thorndike. Nor do we need to think of memory as anything more than the stability against time afforded by the materiality of neurochemical bonds. It was a perspective that Thorndike was quick to establish in the opening of his dissertation:
Our knowledge of the mental life of animals equals in the main our knowledge of their sense-powers, of their instincts or reactions performed without experience, and of their reactions which are built up by experience. Confining our attention to the latter, we find it the opinion of the better observers and analysts that these reactions can all be explained by the ordinary associative processes [stimulus-response bonds] \textit{without aid from abstract, conceptual, inferential thinking} [12, p. 20, my emphasis].

If Thorndike had stopped there—offering the first quantitative measure of animal learning, a measure objectively observable and therefore amenable to the recently developed statistics of inter-rater reliability—he would have had enough for a dissertation, perhaps even a classic. But he went much further.

“The first great question,” he wrote [12, p. 67], “is whether or not animals are ever led to do any of their acts by reasoning.” His conclusion was decisive and, given his switchboard analogy, predictably negative. Based on his observations, Thorndike argued that animals learn by accidental success amidst a “mad scramble” of behaviors [12, p. 72]. In fact, he preferred the term “trial and success” to “trial and error” in his later work to emphasize this point. In the behavior of his laboratory animals, he saw no signs of deliberation, no ideas at work, only the steady strengthening of an effective behavior begun by luck and reinforced by repeated success. He then generalized his findings to account for the anomalous findings in the literature, especially in the work of George John Romanes, Darwin’s life-long friend and intellectual heir. In Thorndike’s words:

No one who had seen the behavior of these animals when trying to escape could doubt that their actions were directed by instinctive impulses, not by rational observation. It is then absolutely sure that a dog or cat \textit{can} open a door closed by a thumb latch or button, merely by accidental success of its natural impulses. If all cats, when hungry and in a small box, will accidentally push the button that holds the door, an occasional cat in a large room may very well do the same. If three cats out of eight will accidentally press down a thumb piece and push open a small door, three cats out of a thousand may very well open doors or gates in the same way [12, p. 73; his emphasis].

But more important than his qualitative observations was his interpretation of the time-curve data (see Figure 1), unequivocal evidence, in his mind, of the stimulus-bond reinforcement process. The gradual diminishing of time on task indicated by the slightly negative slope of the line of best fit, the sawtooth form depicting the intermediate bifurcation of success and error, all working toward the asymptote of the perfectly paired stimulus and response: this was far from the sort of punctuated drop in time on task expected of an animal capable of epiphany, farther still from the permanent time-curve trough expected of an epiphany sustained by memory. “The gradual slope of the time-curve,” concluded Thorndike [12, p. 74], “. . . shows the absence of reasoning. They represent the wearing smooth of a \textit{path in the brain}, not the decisions of a rational consciousness” [my emphasis].
These were late-Victorian times, and therefore a dissertation on animals was tantamount to a disquisition on Darwin. Thorndike’s rival, John Dewey [15] aptly characterized the gravitas of evolution when he compared Darwin to Galileo in terms of the magnitude of revolution brought about in intellectual circles. Religion was never the issue for Dewey; in fact, he complained that the important implications of Darwin’s work were frequently obscured by the attendant theological controversy. What was important was the realization that with *Origin of Species* came a new method of inquiry into natural phenomena based on origin and change. For 2000 years, Dewey explained, knowledge of a natural object resulted from an inquiry into its fixed form and its final cause, the *species* and *telos* of classical antiquity: the essence of a flower, for example, was to be found in understanding the underlying, fixed structure around which its routine change organized and the ultimate end toward which its daily growth progressed. Suggestive in its title, *Origin of Species* rejected this fixity of *species* and recast in the light of dynamic processes what for millennia had been seen as the permanent, perfected substructure of nature. What Galileo said of the earth, Darwin now said of the Aristotelian *species*: *e pur se muove*, “and yet it moves.” In doing so, concluded Dewey [15, p. 9], Darwin “emancipated, once for all, genetic and experimental ideas as an organon of asking questions and looking for explanations.”

Thorndike likewise praised Darwin for his genetic approach to natural phenomena: psychology before Darwin had assumed that all human minds were of “one pattern,” Thorndike [16, p. 37], would later explain; Darwin’s contribution was the realization that “the mind not only is, but has grown... and that the mind’s present can be fully understood only in the light of its total past” [16, p. 37]. That the human mind’s total past implicated animal learning within Darwin’s genetic approach was essential to Thorndike’s work, for it enabled him to study the behavior of animals—which were far easier to acquire than human subjects, as his Harvard days had taught him—and generalize his findings to human phylogeny. “Amongst the minds of animals,” wrote Thorndike in 1901, “that of man leads, not as a demigod from another planet, but as a king from the same race” [12, p. 294].

In the opening of his doctoral dissertation, Thorndike foregrounds this evolutionary continuity by elaborating the “chief pursuit of comparative psychology” along phylogenetic lines. “The main purpose of the study of the animal mind,” he declares, “is to learn the development of mental life down through the phylum, to trace in particular the origin of human faculty” [12, p. 22]. In the laws wrested from the behavior of his laboratory animals, Thorndike believed he saw the developmental parameters of the protohuman mind. But what enabled him to extrapolate from human phylogeny to human ontogeny, from the chicks,
dogs, and cats signifying ancestral human behavior to the modern child occupying a desk at a nearby school? After all, Thorndike was not content with drawing parallels between his laboratory animals and the history of humankind, the kind of work warranted by the thesis of evolutionary continuity. His was a more ambitious, more practical concern: to understand the modern human mind, the child’s in particular, on the basis of his experiments with animals. In fact, in the opening chapter of his dissertation, so seamless is Thorndike’s passing between the realm of the animal and that of the child, so unproblematic is his conception of a unified “psychology of animals and children” [12, p. 3], modern readers are likely left wondering: What enabled him to speak of such things in one easy breath?

The popular theory of recapitulation would have afforded the warrant. The idea that in its own biological development, an organism passes through the adult form of each of its evolutionary ancestors—that ontogeny recapitulates phylogeny—emerged out of the romantic biology of Lorenz Oken and J. F. Meckel in Germany and Etienne Serres and his mentor, Etienne Geoffroy Saint-Hilaire, in France, reaching its zenith in the last quarter of the 19th century in the hands of the German naturalist and popularizer, Ernst Haeckel [17]. In its ordering of the natural world from the smallest protista to the grandest designs, recapitulation theory was second only to Darwin in shaping Western biological thought at century’s end. Forty years after his epiphany, Serres still regaled:

I did not know how to express the feeling of admiration that I felt for the grandeur of the creation in general, and for that of man in particular, when I saw that, at a first stage [of ontogeny], the human brain resembled that of a fish; that at a second stage, it resembled that of reptiles; at a third, that of birds; and at a fourth, that of mammals, in order finally to elevate itself to that sublime organization that dominates all nature [17, p. 47].

“The whole animal kingdom is none other than the representation of the several activities or organs of Man,” wrote Oken in 1847, “naught else than Man disintegrated” [17, p. 45]; later in the same text, Oken articulated a typical recapitulation series:

During its development the animal passes through all stages of the animal kingdom. The foetus is a representation of all animal classes in time.

At first it is a simple vesicle, stomach, or vitellus, as in the Infusoria.

Then the vesicle is doubled through the albumen and shell, and obtains an intestine, as in the Corals.

It obtains a vascular system in the vitelline vessels, or absorbents, as in the Acalephae.

Within the blood-system, liver, and ovarium, the embryo enters the class of bivalved Mollusca.
With the muscular heart, the testicle, and the penis, into the class of Snails.

With the venous and arteriose hearts, and the urinary apparatus, into the class of Cephalopods or Cuttle-fish.

With the absorption of the integument, into the class of Worms.

With the formation of branchial fissures, into the class Crustacea.

With the germination or budding forth of limbs, into the class of Insects.

With the appearance of the osseous system, into the class of Fishes.

With the evolution of muscles, into the class of Reptiles.

With the ingress of respiration through the lungs, into the class of Birds. The foetus, when born, is actually like them, edentulous [toothless].

Goethe, Tennyson, Freud, Dewey—all served as ambassadors of recapitulation to the arts and science communities of Europe and America, and yet, recognizing them as having succumbed to pragmatist thinking, Thorndike rejected the theory entirely. “Heaven knows that Dame Nature herself in ontogeny abbreviates and skips and distorts the order of the appearance of organs and functions, and for the best of reasons,” wrote the 23-year-old [12, p. 150]. He continues:

We ought to make an effort, as she [nature] does, to omit the useless and antiquated and get to the best and most useful as soon as possible: we ought to change what is to what ought to be, as far as we can. And I would not advocate this animal-like method of [student] learning in place of the later ones unless it does the same work better. I simply suggest that in many cases where at present its use is never dreamed of, it may be a good method. As the fundamental form of intellection, every student of theoretical pedagogy ought to take it into account [his emphasis].

In “the best of reasons,” in the shedding of the useless in favor of the effective, all in relation to local circumstances, Thorndike presents the germ of his utility theory, the prominent alternative to recapitulation at the turn of the century: it was not the parade of ancestral features ineffably linked to ontogeny that ordered the developmental stages of the child; it was natural selection itself. Ontogeny was thus flexible, facile, responsive. As he would later elaborate:

The Utility Theory explains the dates of original tendencies by the same causes as account for their existence—variation and selection. Other things being equal, the date at which a tendency appears is that one of the many varying dates at which it has appeared in our ancestry which has been most serviceable in keeping the stock alive. Thus, suckling, though late in the race, is early in the individual. The sex instincts, though early in the race, are very late in the individual [18, pp. 105-106].

Gould [17, p. 153] aptly characterized Thorndike’s utility theory as “a Darwinian proposal that childhood behaviors arise by selection for immediate benefit
(and tend to be expressed by inheritance at the same developmental stage in descendants, unless modified by new selection pressures acting upon these future generations” [my emphasis]. That organisms of different species resemble one another in neurophysiology as they pass through similar developmental stages: it was this notion, which underwrote the latter half of Thorndike’s 1898 work, that warranted his analogical leap from animal to child, a notion long attributed to the theory of embryonic similarity espoused by Königsberg’s eminent embryologist, Karl Ernst von Baer. Described by Huxley as Darwin’s equal [17, p. 52], von Baer saw in the development of the embryo a process of progressive differentiation, a moving from an initial, relatively amorphous state common to all organisms to states of increasingly specialized structure and function common only to the species at hand. In his Entwickelungsgeschichte of 1828, von Baer writes:

The grade of development of an animal body consists of the greater or lesser extent of heterogeneity in the parts that compose it. . . . The more homogeneous the entire mass of the body, the lower the stage of development. We have reached a higher stage if nerve and muscle, blood, and cell-material are sharply differentiated. The more different they are, the more developed the animal [17, p. 55].

It was not that the human fetus transmuted from mollusc to worm to fish to reptile on its way to its pinnacle form, as Oken and others would have it; rather, like the mollusc, like the worm and fish and reptile, the human embryo starts from simple beginnings and increases in complexity over time, which, while affording some semblance of the embryos of lower species along the way—not the adults of Haeckel’s thinking—falls far short of resembling the lower species in any ontological sense. Paraphrasing von Baer, Gould [17, p. 53] explains:

The mode of life of an embryo often precludes any complete repetition of lower forms: the mammalian embryo, lying in its placental fluid, can never be a flying bird or an air-breathing insect. . . . [T]he chick embryo, at one stage, has a heart and circulation very much like that of a fish, but at the same time it lacks “a thousand other things” that all adult fishes possess.

In Animal Intelligence, Thorndike extrapolates from his laboratory animals to human ontogeny on the grounds of structural similarity with respect to developmental complexity. In essence, he extends von Baer’s theory of embryonic similarity to the post-embryonic mind, which enables him to place child pedagogy on a firm experimental foundation, law-abiding in nature owing to his mechanistic conception of mind, without his ever having had access to children.

CLASSROOM IMPLICATIONS

It was not that Thorndike’s analogies altogether obviated the need for advanced forms of cognition in explanations of animal behavior; it was that through the
switchboard analogy, through its passive connection of stimulus to response in the most immediate and material ways, Thorndike came to think of ideas as secondary effects, epiphenomena resulting from the large aggregates of highly developed associative bonds common to higher animals and adult humans, bonds that had developed along the lines of delicacy, complexity, quantity, and durability. In the case of the associative network comprising feline consciousness, Thorndike [12, p. 122] wrote, “[s]uch soil cannot grow general ideas, for the ideas, so long as they never show themselves except for a particular practical business, will not be thought about or realized in their nature or connections.” However, he does leave room for the possibility that with further phylogenetic development, ideas may bloom:

If enough associations are provided by a general curiosity, such as is seen among the monkeys, if the mental elements of the association are freed, isolated, felt by themselves, then a realization of the ideas, feelings of their similarity by transition from one to the other, feelings of qualities and of meanings, may gradually emerge [12, p. 122].

This idea that ideas are secondary phenomena that grow slowly over phylogenetic time and only in the rich soil of a sophisticated associative network, coupled with the extension to human ontogeny afforded by von Baer’s analogy, led Thorndike to reason that modern humans do not experience ideas until they have grown well beyond infancy into childhood and play. The mind of a child less than one year old, argued Thorndike [12], was that of an animal, operating solely on the basis of stimulus-response bonds too coarse and too few to manifest ideas:

The next important fact is that the intellect of the infant six months to a year old is of the animal sort, that ideational and reasoning life are not present in his case, that the only obvious intellectual difference between him and a monkey is in the [potential] quantity and quality of the associations formed. In the evolution of the infant’s mind to its adult condition we have the actual transition within an individual from the animal to the human type of intellect [12, p. 288].

Young children and adult non-primate animals were too “young”—ontogenetically in the first case, phylogenetically in the second—to have ideas. We could gain a glimpse into their world, Thorndike believed, if we placed ourselves in fight-or-flight situations, which stripped from behavior all mediation by ideas or intent: “The loop [in the puzzle box] is to the cat what the ocean is to a man, when thrown into it when half-asleep,” wrote Thorndike [12, p. 119]. “The reaction is not to a well-discriminated object, but to a vague situation.” Elsewhere, Thorndike offered less dire scenarios for entering into a zoomorphic experience:

[T]he intellectual life of a cat or dog . . . is most like what we feel when consciousness contains little thought about anything, when we feel the sense-impressions in their first intention, so to speak, when we feel our own body, and the impulses we give to it. Sometimes one gets this animal consciousness
while in swimming, for example. One feels the water, the sky, the birds above, but with no thoughts about them or memories of how they looked at other times, or aesthetic judgments about their beauty; one feels no ideas about what movements he will make, but feels himself make them, feels his body throughout. Self-consciousness dies away. Social consciousness dies away. The meanings, and values, and connections of things die away. One feels sense-impressions, has impulses, feels the movements he makes; that is all [12, p. 122].

I believe that our best service has been to show that animal intellection is made up of a lot of specific connections, whose elements are restricted to them, and which subserve practical ends directly, and to homologize it with the intellection involved in such human associations as regulate the conduct of a man playing tennis [12, p. 154].

It is in the “increase in the delicacy of structure of the human brain and the consequent increase in the number of associations,” writes Thorndike [12, p. 290], that “we have, I think, the manner in which the vague feelings of the nine-months-old infant become the definite ideas of the five-year-old boy, the manner in which in the race the animal mind has evolved into the human.” Yet even in the five-year-old boy, mastery of many essential skills was not thought to be aided by imitation or instruction. In the closing of his dissertation, Thorndike draws on the ethos of classroom teachers to develop a line of argument that ultimately leads to their marginalization:

Now every observant teacher realizes how often the cleverest explanation and the best models for imitation fail. Yet often, in such cases, a pupil, if somehow enticed to do the same thing, even without comprehension of what it means, even without any real knowledge of what he is doing, will finally get hold of it. So, also, in very many kinds of knowledge, the pupil who does anything from imitation, or who does anything from being put through it, fails to get a real and permanent mastery of the thing. . . . I am inclined to think that in many individuals certain things cannot be learned save by actual performance. . . . We are here alongside the foundations of mental life, and this hitherto unsuspected law of animal mind may prevail in human mind to an extent hitherto unknown [12, pp. 149-150].

Like the animals of his studies, students too must “learn by doing,” a practice tantamount to learning by repetition in Thorndike’s vision, since it is after all the useful bonds between stimulus and response and not the ideas themselves, not comprehension itself, that need to be strengthened, “paths worn smooth” in his language. Rote learning was therefore touted as the logical conclusion for a science of pedagogy that claimed fidelity to the facts. Teaching, as Thorndike [16, p. 61] would later say, was a matter of “giving and withholding stimuli with the result of producing or preventing certain responses.” To some degree, progressive theorists following Dewey might have been persuaded to agree with Thorndike’s definition, if “giving and withholding stimuli” were seen as a valuing
of the role of the teacher in the classroom, and the “certain responses” of the
students an indication that reflective thinking leading to informed action was
the ultimate goal of education. But Thorndike’s mind was elsewhere. Of the
ideally educated student, he [16, p. 89] wrote in 1922:

He should not as a rule have to think in such a fashion as: “Is this interest
or discount? Is it simple interest or compound interest? What did I do in
compound interest? How do I multiply by 2 percent?” The situation that
calls up interest should also call up the kind of interest that is appropriate,
and the technique of operating with percents should be so welded together
with interest in his mind that the right cooperation will occur almost without
supervision by him.

Like that of “Dame Nature herself,” the role of the teacher was limited to
exposing students to the right kind of stimuli in accordance with the laws of
learning, to “make an effort, as she [Nature] does, to omit the useless and
antiquated and get to the best and most useful as soon as possible” [12, p. 150].
Thorndike drew a predictable parallel to the task of the animal trainer: “The best
way with children may often be, in the pompous words of the animal trainer, ‘to
arrange everything in connection with the trick so that the animal will be com-
pelled by the laws of his own nature to perform it.’”

CONCLUSION

In the switchboard metaphor, with its framing of mind as a collection of
neurochemical bonds, nomothetic in nature and therefore amenable to psycho-
metric science, and in the small acts of repetitive learning, all exported from
the animal to the child by way of an analogy afforded by von Baer’s theory of
embryonic similarity, Thorndike’s analogy-making fixed the site of scientific
inquiry deep within the child, within the brain itself, and far from the in situ
reach of teachers. “Intellect, character and skill have their physiological basis
in the structure and activities of the neurones and accessory organs which
compose the nervous system,” emphasized Thorndike [18, p. 84], and it was
the experimental analysis of that basis that comprised the new science of
education. The whole of original nature was precisely the behavioral effect of
our common associative inheritance; learning, the associations that were created
and broken over the course of life. In broad strokes, Thorndike’s analogies
created an intellectual vision that subordinated the gross behavior of the child
to the intricate dynamics of the underlying stimulus-response bonds, which
likewise subordinated the role of the teacher to that of the educational researcher,
a new professional who, with expertise in statistical methods, psychology,
and neurology, served alongside administrators in the making of the modern
American school.
REFERENCES


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