**Psychology’s Darwin: From the Law of Effect to Cognitive Rules**

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 In a footnote to an article I wrote in 2014, I mentioned that I had heard it said that psychology is still waiting for its Darwin. That is, it is waiting for someone to provide the kind of pivotal concept that evolution provides for the (other) biological sciences.1 But, as I stated then, I think we’ve already had our Darwin and his name is Edward Thorndike.

 I doubt that most readers have heard of Thorndike (1874-1947), but he was a remarkable man.2 After graduating in 1895 from Wesleyan University, with the highest grade average in 50 years, he studied with William James at Harvard. While there, he did research on intelligence in chickens. It is difficult to imagine James being sympathetic to the topic, but he must have been; when Thorndike’s landlady objected to baby chicks being kept in his room, he was allowed to move them to the basement of James’ house. There he built a maze in which the chicks slowly learned to race to food, water, and the company of other chicks. Thorndike concluded that although the observed learning didn’t reveal intelligence, it revealed something more basic; acts that lead to pleasure are repeated, and acts that don’t, aren’t.

 Thorndike left James and Harvard to finish his Ph.D. at Columbia with James McKeen Cattell, who, like James, was another founding figure in modern psychology. This time he studied cats and how they learned to escape from a ‘puzzle box’. On the basis of his chicken and cat research, Thorndike formulation a theory of learning called ‘connectionism.’ It had two laws; the Law of Effect, which said that the effect of an action (either annoying or satisfying) in particular circumstances determines whether it will be repeated in the same circumstances, and the Law of Exercise, which says that the more frequently the action occurs in the annoying circumstances, the more strongly the circumstances and action are connected. Of the two, the Law of Effect was the more fundamental because it postulates a connection and how that connection comes to be established; the Law of Exercise is just a technical detail about what determines the connection’s strength.3

 Although the Law of Effect may have expressed a core truth, it did so in general terms. It did not define annoying or satisfying effects nor did it propose a precise mechanism by which associations are strengthened or weakened. Indeed, it did not even say what connections are. But, these issues subsequently were addressed in Thorndike’s elaboration of his connectionist theory and in his research, as well as the research of a great number of experimental psychologists during the 50 year ascendancy of Behaviorism—from about 1913 until well into the 1960’s—which was built on his theory. The Law of Effect was abbreviated as stimulus-response (S-R) conditioned reflexes that, thanks to Pavlov, were assumed to resemble naturally occurring sensory-motor reflexes. Annoying and satisfying effects were investigated under the rubric of positive and negative reinforcers and the connection mechanisms were examined under the rubric of classical and operant conditioning. Connections were characterized as neurological and were studied by ablating selected areas of the brain and, more recently, using MRI and similar techniques.

 Although it has been liberalized in light of modern interpretations of connections, such as the requirement of awareness of contingencies (at least for humans, e.g., Dulany, 1968), connectionism remains a feature of numerous areas of neuropsychology and learning research (aversion learning, for example). Behaviorism, on the other hand, has pretty much faded from the scene, in some sense a victim of its own success. Behaviorism’s fundamental “anti-mentalism” tenet forced three or four generations of researchers to reject mind as an explanatory concept and to speak and think of behavior in more rigorous terms. With time, as ideological fervor diminished, they were able to bring this rigor to bear on what had once been the domain of mind, thus giving rise to a new cognitive psychology that has since become part of the broader field of cognitive science.

From Connections to Rules

 As the behaviorist fever diminished, making room for the present-day cognitivist viewpoint, it became necessary to reconsider connectionist theories of learning. Empirically, there could be no question that some forms of learning were well-characterized as connectionist; that the Law of Effect accounted for the data. And, there was an abundance of data; the Behaviorists were highly productive experimenters. The problem was that these data didn’t have much to say to the emerging cognitivist viewpoint.

 Albert Bandera, the most visible early proponent of the cognitivist viewpoint, used connectionist terminology to talk about cognitive events that previously been off limits to Behaviorists. But, neither he nor others like him addressed how the Law of Effect squared with the new viewpoint. At the risk of immodesty and acknowledging that the idea had its roots in the thinking of the time, I think that the first explicit reinterpretation of connections was in an introductory psychology textbook I published in 1973 in which the stimulus-response connection was discussed as a cognitive rule rather than a neurological reflex. That is, classical conditioning (Pavlov’s ‘conditioned reflex’) was reinterpreted as a rule about what to expect when a particular circumstance is encountered; a *What-to-expect Rule*. Operant condition was reinterpreted as a rule about what to do when a particular circumstance is encountered; a *What-to-do Rule*. The general form of these rules, and of the Law of Effect, is If-Then; if this occurs, then that will happen. In most cases, the link between the If and the Then is causal or interpreted as causal. I elaborated on these rules, and the If-Then form, in my first book on narrative structure and narrative thought (Beach, 2010).

 I grow old. In the 1950’s, I was an undergraduate at Indiana University, where Behaviorism prevailed (B.F. Skinner had only recently departed for Harvard). I recall being called out by a professor, in front of an entire class, for being a ‘mentalist’ because I had used the word mind in a sentence as innocent as “I changed my mind.” I struggled to toe the party line. I tried to talk and think in the elliptical ways required to fit everything into the S→R, connectionist mode. But it didn’t work. Fortunately, in graduate school at the University of Colorado, I encountered the rumblings of the new cognitivist revolution, first with Michael Wertheimer and next with Kenneth Hammond. Wertheimer introduced me to Gestalt perceptual research, opening the European alternative to Behaviorism, and Hammond introduced me to the work of Egon Brunswik, opening the idea of a multi-causal psychophysics of perceptual experience based on the ‘Lens Model’ and multiple regression. Both were major revelations to a refugee from S-R connectionism. By the time I graduated in 1961 and went to the Navy and on to a post-doc at Michigan, most universities were forsaking Behaviorism in favor of more liberal, but rigorous, ways of characterizing behavior. By 1966, when I took my first teaching job at the University of Washington, research on learning was rapidly yielding center stage to research on perception, memory, reasoning, and language—the foundations of a new cognitive psychology that later merged with linguistics and other disciplines to form cognitive science.

 Unfortunately, Thorndike and his Law of Effect got lost in the enthusiasm to move beyond Behaviorism. Nobody repudiated him, but few talked anymore about the old triumvirate of Thorndike, Pavlov, and Skinner. Instead, the focus was on the computer analogy that spurred the next cognitive revolution, and information processing became the primary metaphor for cognition. Even then, If-Then rules remained central, if only because they are at the core of computer programming and, thus, at the core of the information processing metaphor. In both the 2010 and 2016 books on TNT, I explained how all of this leads to the next cognitive revolution, of which TNT may yet play a part—we’ll see.

 Every idea has its roots. And, I would like to acknowledge the Law of Effect as the root of the fundamental organizing principle for narrative thought, causal rules. In doing this, I would like to pay tribute to Edward Thorndike for his gift to psychology in general and TNT in particular. Since its publication in 1898, his Law has played a central role in scientific psychology, in one form or another, and shows no sign of being displaced. I think this justifies regarding him as our Darwin.

References

Beach, L. R. (1973). *Psychology: Core concepts and special topics*. New York: Holt, Rinehart, and Winston.

Beach, L. R. (2010). *The psychology of narrative thought: How the stories we tell ourselves shape our lives*. Bloomington IN: Xlibris.

Beach, L. R., Bissell, B. L., & Wise, J. A. (2016). *A new theory of mind: The theory of narrative thought.* Newcastle-upon-Tyne, UK: Cambridge Scholars.

Dulany, D. E. (1968). Awareness, rules, and propositional control: A confrontation with SR behavior theory. In T. Dixon & D. Horton (eds.). *Verbal behavior and general behavior theory*. New York: Prentice-Hall. (pp. 340-387).

Hunt, M. (1994). *The story of psychology*. New York: Anchor.

Powers, W. T. (1973)*. Behavior: The control of perception.*Chicago: Aldine de Gruyter.

# Powers, W. T. (1973)*.* Feedback: Beyond behaviorism*. Science, 26, 179, 4071, 351-356. DOI: 10.1126/science.179.4071.351.*

Thorndike, E. L. (1898). Animal intelligence. *Psychological Review Monographs, Supplement no. 2*.

Footnotes

 1 Of course, evolution is central to psychology as a biological science but, in addition, we need something more specific to our level of discourse.

 2 My source for all of this is an excellent history by Morton Hunt (1994). Incidentally, Thorndike also authored a popular dictionary, now called the Thorndike-Barnhart dictionary.

 3 Although Thorndike’s statement of his law varied a bit from time to time, the kernel is that behavior that has resulted in a satisfying state of affairs increases in frequency in the setting in which the behavior previously occurred and the opposite happens when behavior has resulted in an annoying state of affairs.

Addendum

*My colleague, Jim Wise, comments*:

However enlightening and informative this historical retrospective, I cannot bring myself to agree that Thorndike is psychology’s Darwin, even though he might be one of its under-appreciated figures. That’s because he, arguably, began everything that TNT has shown to be insufficient. One cannot get to the insights of the theory by building upward from connectionism. Narrative thought is not, in its essence, about connectionism. It’s about closure and bundling. It’s about taking a set of connections over an interval of time, and bringing the end of that set back to the beginning via a mental rotation or reflection operation. It’s closing an overriding mental loop of cause and effect and ancillary events into a purposeful understanding of what’s happening and is therefore likely to happen.  Rotational closure is the older evolutionary accomplishment. It went to the Asian continent with the first great hominid diaspora (Homo Erectus) from East Africa and left its mark in the religions and ‘inscrutability’ of Eastern Thought that Kipling found so elusive. Reflection is newer, having arrived a million or so years later, accompanying Homo Sapiens into Eurasia and becoming the foundation of Western Thought. Its addition into our cognitive toolkit fully formed the Piaget Group that comprises fundamental modern human cognition worldwide.

  The continuous linkage of cognition back to lower forms of neural guided behavior is not at the level of the connections themselves, but at the level of the neural control loop, which forms the proper ‘unit of analysis.’ Once analysis is made on this level, everything falls into place. This does not negate the laws of connectionism, but simply puts them in proper perspective.  From this point of view, if there is a Darwin for psychology, it is William T. Powers and his landmark article in Science following his book “Behavior: The Control of Perception” in 1973.  This turned the whole S-R formalism on its head and showed how the simple misdirection from S to R and failure to recognize closure through feedback in neural systems caused all of psychology’s problems.

  That said, Powers missed one crucial aspect: He bent the control loop too soon, keeping it within the sensory apparatus of the organism.  What a shame! Follow the loop out, into the ‘real world’. Don’t shorten the loop!  Powers made the same mistake that the physicists have always made. They accepted an implicit hard boundary between ‘organism’ and ‘environment’ when at the level of information loops there is no need for one.

  By starting at the level of narrative, TNT doesn’t establish artificial distinctions that only gum up theoretical understanding. So it should not go back on a reductionist path to Thorndike and connectionism to find its roots. Rather, it should stay at the level of the control loop in neural terms and at the level of the Group in mathematical terms. Powers was a control systems engineer, and Piaget was a self-described ‘genetic epistemologist’.  Ironically, psychology’s Darwin(s) weren’t psychologists.