

B. F. Skinner - Mnemonic For His Contributions To Precision Teaching

Ogden R. Lindsley

I have often described the contributions of B. F. Skinner to Precision Teaching and Standard Celeration charting. Here's a mnemonic to help you list the most important of these.

B = Behavior
F = Frequency
S = Standard slope charts
K = Kid knows best
I = Induction
N = N of 1
N = No observer
E = Environment
R = Relationship recording

How Necessity Mothered This Mnemonic

While making last-minute preparations for travel to the 1991 American Psychological Association meetings in San Francisco, I disciplined myself to answer, before leaving, the many letters and reprint requests that had accumulated on my desk. This produced a stack of 9 by 12 inch manila envelopes too large to carry easily. So, I put them in one of my empty aluminum Halliburton briefcases. Before boarding the airplane, I would drop by the airport post office, which never has a line, and mail them.

I always carry two carry-on pieces of luggage, 1) my Halliburton briefcase containing my tickets, hotel reservation information and the vital notes, transparencies, and hand-outs for my talk; and 2) my carry-on bag with toilet articles, spare blue shirt, extra tie, running suit and shoes. For a three or four day trip, I need an extra suit and shirts, so I check a second long-trip bag with the extra clothing items. This conditions me always to have two bags, and on long trips a third bag with me. It is good to carry something in each hand, so I am well balanced for long walks to remote gates in large airports (e.g., Chicago, Dallas, and Atlanta). Always carrying a bag in each hand when both leaving and returning eliminates the tendency to leave a brief case at an airport counter, restaurant, phone, or restroom. Each hand must always carry something.

As I left our home, I carefully put my aluminum

briefcase, my carry-on bag and my larger long-trip bag in my car (my three items for long trips). I drove the 65 miles to Mid-continent International Airport in Kansas City. I proudly mailed the contents of the briefcase at the airport post office, parked my car in the satellite lot, and took out my bags. As I picked up the aluminum case, I suddenly realized that it was too light! It was empty! I had just mailed its contents! The second aluminum case with my carefully selected presentation materials and in-flight work was still 65 miles away in our kitchen. I had but 30 minutes before flight time. My carefully designed system for not forgetting luggage had backfired because this time I had two briefcases instead of my usual one. I had four pieces to put in my car instead of my usual two or three pieces.

There was nothing to do but, relax, laugh at my error, and get on the plane. I purchased new tickets with my American Express card and boarded the plane like a tourist with clothes only. I had no papers to edit, no letters to answer, no work to do on the long flight to San Francisco through Salt Lake City. Sitting in the seat, I thought, what about my talk? No manuscript, no notes, no transparencies, no hand-outs! Well, I will just have to "wing it." Claudia McDade had listed my talk as "The roots of Precision Teaching -What we know that isn't so." I will have to list the things that we got from Skinner on a clear mylar at the overhead projector. I might forget an important one while on my feet in the auditorium. As a

check, I tried to list them there in my airplane seat. Even though I have recently written several articles listing Skinner's contributions to Precision Teaching (Lindsley, 1991a, 1991b, 1991c), I could spontaneously list only a few. This was a sure sign that I needed a memory aid.

Mnemonics and Other Mediators

The first memory aid I recall was taught to me at about eight years of age by my father. It helped recalling the colors and sides of boat navigation lights. The short words - Red, Left, and Port go together, and the long words - Green, Right, and Starboard go together. I later added Hot and Cold for the lavatory water taps to my father's memory aid. The first academic mnemonic I learned was "On Old Olympus' Towering Tops A Finn And German Viewed Awesome Hops." This jingle helped listing the 12 cranial nerves in numerical order: Olfactory, Optic, Ocular motor, Trochlear, Trigeminal, Abducent, Facial, Auditory, Glossopharyngeal, Vagus, Accessory, Hypoglossal. A book of hundreds of mnemonics has the title WASPLEG - a mnemonic for the 7 deadly sins: Wrath, Avarice, Sloth, Pride, Lust, Envy, Gluttony (Benne, 1988).

In *Verbal Behavior* Skinner called mnemonics formal self-prompts and gave the medical student cranial nerve jingle as an example (Skinner, 1957, p. 406). He did not mention the word mediation. In *Schedules of Reinforcement* mediating behavior was defined in the glossary as:

Mediating behavior: Behavior occurring between two instances of the response being studied (or between some other event and such an instance) which is used by the organism as a controlling stimulus in subsequent behavior (Ferster & Skinner, 1957, p. 729).

In his glossary for "Mathetics," a classic programmed instruction article, Tom Gilbert defined a mediator as:

Mediator: An act interposed between the stimulus and the response of an operant to insure that the operant will occur until reinforcement gives it sufficient strength: S--(r • s)--R (Gilbert, 1962, p. 72).

Gilbert considered "mediation analysis" important, making it one of the four kinds of information necessary for a mastery prescription. Gilbert offered his resistor color code mnemonic as an example (Gilbert, 1962, p. 27, pp. 59-63):

- a FIVE dollar bill is GREEN

- ZERO; BLACK nothingness
- ONE BROWN penny
- a RED heart has TWO lobes
- a WHITE cat has NINE lives
- THREE ORANGES
- SEVEN PURPLE seas
- a FOUR legged YELLOW dog
- a BLUE tail fly has SIX legs
- an EIGHTY-year-old man has GRAY hair

Later, in *Human Competence*, he devoted 8 pages to mediators, describing mediation as the third of four principles of discrimination training. As mediation examples he gave letters shaped as objects (d=duck, a=apple, e=elephant, f=flag, I=indian, T=table, s=snake) for teaching letter sounds, and repeated his resistor color code mnemonic (Gilbert, 1978, pp. 289-294). He stated that "mnemonics is just one form of mediation" (Gilbert, 1978, p. 306).

Several Precision Teaching mnemonics have been developed. "PRICE": Pinpoint, Record, Intervene, Chart, Evaluate lists the steps in a behavior management project (Lindsley, 1971). "PRACTICED": Particular, Rapid, Added, Counted, Timed, Informed, Charted, Errorful, Daily lists the requirements for practice sessions. "MUSIC": Multiply, Unique, Specific, Independent, Consequated lists the counter-intuitive discoveries made by Precision Teaching. "REAPS": Retention, Endurance, Application, Performance Standards, for listing the products of fluency (Haughton, 1981). To this I added "FUN": Fun, Understanding stimulated, No cheating, as further fluency products. "SAFMEDS": Say, All, Fast, a Minute, Every Day, Shuffled lists the requirements for fluency card practice. I have recently described some of these along with other behavior analytic acronyms (Lindsley, 1991d).

B. F. Skinner Contributions Mnemonic

In the air between Kansas City and Salt Lake City on the inside of my Delta ticket folder I scribbled:

- B = Behavior (cycle and results)
- F = Frequency (count per time)
- S = Standard slope (charts)
- K = Kid knows best (learner decisions)
- I = Induction (teaching and research strategy)
- N = N of 1 (teaching and research tactic)
- N = No observer (self recording)
- E = Environment (selects and controls behavior)
- R = Relationships (recorded directly)

This mnemonic outlined my APA presentation. The audience welcomed it. Most of these Skinner contributions to Precision Teaching, and their particular relevancies have been described in detail (Lindsley, 1971, 1991a, 1991b, 1991c). Here I will briefly only summarize them.

B = Behavior Cycle and Results

During the first 5 years of Precision Teaching we gave a lot of attention to behavior cycles (Lindsley, 1964). The early Standard Behavior Charts had "movement cycle" where "counted" now appears. In the Behavior Research Company one week Short Courses we spent the first morning on how and what to count. A behavior cycle was over when a new one could begin. You counted the salient (e.g., jumps out at you) part of the cycle. You ignored the beginning and end of the cycle because attending to them interacted with the counting. For example, you counted each time the headache intruded. Watching for the beginning of a headache often seemed to create a headache. Watching for the end of a headache often prolonged it.

In 1965 I developed the Dead-Man test to determine whether you had really pinpointed a behavior or just a bodily position. The Dead-Man test was, "if a Dead-Man can do it, it isn't behavior."

Skinner said you could count either behavior or its effects (Skinner, 1938, p. 6). Skinner went on to say the best measure is counting the results of behavior (Skinner, 1938, p. 38). Tom Gilbert has labeled these results of behavior, accomplishments (Gilbert, 1978). In workshops in 1962, Tom said, "Behavior you take with you, accomplishments you leave behind." I have called this Gilbert's Leave-It test for accomplishment: "If you can leave it behind, it's an accomplishment."

Both the Dead-Man and Leave-It tests have been recently more fully described (Lindsley, 1991d). The Dead-Man test has been used successfully in changing the interpretation of a published example of the reinforcement of being quiet in a dental chair (a dead man keeps quiet) to the punishment of disruption (Malott, 1991). Many of the published effects of positive reinforcement with severely disturbed and autistic persons are similarly misunderstood punishment contingencies.

F = Frequency - Count per Time

In other articles I have described Skinner's contribution of frequency and its power in detail (Lindsley, 1991a). In summary, the powers of

frequency are that it is: universal, sensitive, productive, a dimension of behavior, and it directly states the probability of occurrence.

The universality of frequency is shown by the frequency spectra used successfully in optics, sound, electricity, and electromagnetic radiation. Frequency puts behavior in the cgs (centimeter-gram-second) system with the major laboratory sciences. Stephen Graf recently called my attention to the fact that Buckminster Fuller wrote that only angle and frequency define all experiences (Edmondson, 1987, pp. 65-67). Hull's four allegedly different response measures: A- reaction amplitude or duration, str- latency, n- trials to extinction and p- percent of occurrence (Hull, 1943) are all just different frequencies.

The sensitivity of frequency to variables that change behavior is shown by comparing it to other behavior measures. In recording the effects of drugs on free operant human behavior, we found frequency to be 50 to 100 times more sensitive than percent correct (Lindsley, 1956). Classroom frequencies recorded 40 times more effects of curricular changes than did percent correct from the same practice sheets (Holzschuh & Dobbs, 1966).

The productivity of frequency is shown by Pavlov's discovery of the laws of classical respondent conditioning by monitoring salivary drop frequencies (Pavlov, 1927). Skinner developed free operant conditioning by monitoring rat lever pressing frequencies (Skinner, 1938). Schedules of reinforcement were developed by monitoring pigeon key pecking frequencies (Ferster & Skinner, 1957). The multiply world of behavior and behavioral independence were both discovered from human frequency of Behavior Charts. Behavioral fluency and its results were discovered from human frequency charts (Haughton, 1981). All in all, frequency monitoring is probably the most highly productive, practical, and scientific behavioral method.

The probability of occurrence is directly recorded by frequency. Skinner thought probability was a very important aspect of frequency. The curve permits immediate inspection of rate and changes in rate. Such a datum is closely associated with the notion of probability of action (Ferster & Skinner, 1957, p. 7).

Frequency records what most people want to know about a behavior. What is the probability that it will occur? How often can I expect to find it? How often will I make errors? How often will

I be able to do it?

That frequency is more than a mere measure of behavior, that it is actually a dimension of behavior, can be easily demonstrated. Write your full name as slowly as you can for 5 minutes. Just barely keep the pencil moving. You should write no faster than 2 to 5 letters per minute. Note your signature when finished. About 7 out of 10 people write their 2nd or 3rd grade signature when writing as slowly as they can. This is frequency regression. Call out the old frequency and out comes the old behavior that has been dormant for decades. *Change the frequency and you change the behavior.* It is as simple as that. What better proof that frequency is a dimension of behavior?

S = Standard Slope Charts

The fact that the cumulative response recorder actually produced charts whose slopes were frequency and were standard for each species studied has been previously described (Lindsley, 1991a, 1991b). There were standard rat speed recorders (Skinner, 1938), pigeon speed recorders (Ferster and Skinner, 1957), and human speed recorders (Lindsley, 1956). A slope of 45 degrees was 4 per minute on the rat recorders. A slope of 42 degrees was 30 per minute on the pigeon recorders. A slope of 45 degrees was 20 per minute on the human recorders.

These standard frequency slopes gave us the idea for standard celerations on the Standard Celeration Chart. The four reference celerations on a rat recorder calibration grid were 1, 2, 4, and 8 responses per minute. Each is x2 the one below it. An angle of 27 degrees is 2 per minute. The four reference celerations on a Standard Celeration Chart are x1.4, x2, x4, and x16. Each is the square of the one below it. An angle of 34 degrees is x2 per celeration period.

K = Kid Knows Best

This is a slightly less tasteful version of the Precision Teaching slogan, "the child knows best." I dislike using the slightly derogatory "kid" in place of child, but "K" was difficult to match to a Skinner Precision Teaching contribution. My wife, Nancy, later suggested the German "kinder." But that seemed a little academic. Applications of "the child knows best" slogan have been detailed for many years (Lindsley, 1971, 1991b).

I = Inductive Teaching and Research Strategy

The inductive approach used throughout free op-

erant conditioning and Precision Teaching has been covered in detail elsewhere (Lindsley, 1991b). I have suggested the induction ratio of the number of charts collected divided by the number of charts published (CC/CP) to put numbers on a scientist's degree of research induction. Skinner's CC/CP ratios were 40 to 1 for his pioneering free operant rat research (Skinner, 1938) and 78 to 1 for his schedules of reinforcement research with pigeons (Ferster & Skinner, 1957). Skinner's induction doubled in 19 years from 1938 to 1957. Our own Precision Teaching induction ratio has been 51 to 1 for the Behavior Bank (Lindsley, et al., 1971) and 97 to 1 for Precision Teaching Charts (Lindsley, 1990). Our induction doubled in 19 years from 1971 to 1990. Our Precision Teaching research induction is of the same magnitude as Skinner's free operant research induction. Also, Precision Teaching induction doubled in the same time that free operant induction doubled (e.g., x2 in 19 years which equals a celeration of x1.2 every 5 years).

N = N of 1 Teaching and Research Tactic

N of 1 means the number (N) of subjects or learners in the experiment or demonstration equals 1. Each learner serves as his or her own control. All experimental variables are tried on each learner (Johnston & Pennypacker, 1980, pp. 255-257). There are no experimental groups to compare with control groups. Averages have no value in a science of individual behavior. Hear it from Skinner:

A prediction of what the average individual will do is often of little or no value in dealing with a particular individual. The actuarial tables of life-insurance companies are of no value to a physician in predicting the death or survival of a particular patient (Skinner, 1953, p. 19).

Skinner once said when presenting research at a meeting of the American Psychological Association:

In deference to the standards of this association, I now will report on the other rat (Skinner, 1983, p. 123).

N = No Observer - Self-Recording

"No Observer" means just that. The best and most efficient learning occurs with self-counting, self-timing, self-charting. Skinner wrote in his first classic book:

All the figures in this book were made directly by the rats themselves (Skinner, 1938, P. 60).

Problems of observer reliability and validity disappear with self-recording. The only question left is

what was the learner counting? The most valid answer is what the learner says he or she counted. Reliability is revealed by the bounce on the Charts and validity, by the time taken to reach aims.

E = Environment Selects and Controls Behavior

Environment means that you change behavior by changing its environment. Everything you do about behavior is in its immediate environment. You stimulate behavior from its environment. You record the effects of behavior on its environment. And, you accelerate and decelerate behavior by re-arranging its environment. Skinner first called this "environmental control" (Skinner, 1938, p. 55; 1953, p. 227), occasionally "manipulation" (Skinner, 1953, p. 37), and, at the last, "environmental selection" (Skinner, 1990). A better name than "radical behaviorism" for free operant conditioning and applied behavior analysis might well have been "environmentalism." This would have located the behavior causation and control where Skinner meant it to be - in the immediate environment. Simply put, you change behavior by changing its environment.

R = Relationships Recorded Directly

Relationship recording has been used little in free operant conditioning and even less in Precision Teaching. It should be used much more. It means that instead of counting and charting a single behavior or accomplishment, you count and chart the performances that occur under one condition separately from the same performance occurring under other conditions. You count the relationships between the different behaviors and their related events. You count what Skinner meant by reflexes - completed Stimulus-Response relationships.

Relationships were recorded in the multiple and mixed schedules of reinforcement research. For example, with only one key being pecked, fixed interval 15 minute pecking was recorded on one recorder and fixed-interval 8 minute responding recorded on a second recorder (Ferster & Skinner, 1957). Relationship records were the core of my own social research with cooperative responding of two children recorded on one recorder (Azrin & Lindsley, 1956). In another experiment, six cumulative recorders simultaneously recorded socially stimulated and mechanically stimulated leadership between two persons (Cohen & Lindsley, 1964). Relationship records were the key to our powerful laboratory analysis of simultaneous discrimination and differentiation. In these experiments five recorders simultaneously recorded the develop-

ment of different forms of stimulus discrimination and response differentiation (Barrett & Lindsley, 1962).

We called this functional recording and did a little in the early 1970's in improving social behavior between married couples. For example, a husband's attempts to compliment his wife were counted by the wife on one counter if they were received as complimentary, but on a different counter if they were received as criticisms (Duncan, 1971). These charts were useful in sharpening the husband's awareness of the effects of his intended compliments. Such sharpening of the awareness of each member of a couple greatly improved their relationship. Clearly, more relationship charting should be done. It is a rich field for clinical success and research discoveries.

Conclusion

I hope this B. F. Skinner mnemonic helps you the next time you are required to list B. F. Skinner's contributions to Precision Teaching.

References

- Azrin, N. H. & Lindsley, O. R. (1956). The reinforcement of cooperation between children. *Journal of Abnormal and Social Psychology*, 52, 100-102.
- Barrett, B. H. & Lindsley, O. R. (1962). Deficits in acquisition of operant discrimination and differentiation shown by institutionalized retarded children. *American Journal of Mental Deficiency*, 67, 424-436.
- Benne, B. (1988). *WASPLOG and other mnemonics*. Dallas, TX: Taylor Publishing Co.
- Cohen, D. J., & Lindsley, O. R. (1964). Catalysis of controlled leadership in cooperation by human stimulation. *Journal of Child Psychology and Psychiatry*, 5, 119-137.
- Duncan, A. D. (1971). The view from the inner eye: Personal management of inner and outer behaviors. *Teaching Exceptional Children*, 3, 152-156.
- Edmondson, A. C. (1987). *A Fuller explanation*. Birkhäuser: Boston.
- Gilbert, T. F. (1962) Mathematics: The technology of education. *The Journal of Mathematics*, 1 (1), 7- 73. Reprinted in M. D. Merrill (Ed.), *Instructional design: Readings*. Englewood Cliffs, N.J.: Prentice-Hall, 1971.
- Gilbert, T. F. (1978). *Human competence: Engineering worthy performance*. New York: McGraw-Hill.
- Ferster, C. B. & Skinner, B. F. (1957). *Schedules of reinforcement*. New York: Appleton Century Crofts.
- Haughton, E. C. (1981, March). REAPS. *Data Sharing Newsletter*, Waltham, MA: Behavior Prosthesis Laboratory.
- Holzschuh, R. D. & Dobbs, D. (1966). *Superiority of rate correct over percent*

- correct* Unpublished manuscript, University of Kansas Medical Center, Educational Research, Lawrence.
- Hull, C. L. (1943). *Principles of behavior*. New York: D. Appleton-Century.
- Johnston, J. M., & Pennypacker, H. S. (1980). *Strategies and tactics of human behavioral research*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Lindsley, O. R. (1956). Operant conditioning methods applied to research in chronic schizophrenia, *Psychiatric Research Reports*, 5, 118-139.
- Lindsley, O. R. (1964). Direct measurement and prosthesis of retarded behavior. *Journal of Education*, 147, 62-81.
- Lindsley, O. R. (1971). From Skinner to Precision Teaching: The child knows best. *Let's Try Doing Something Else Kind of Thing*. Arlington, Virginia: Council for Exceptional Children. 1-11.
- Lindsley, O. R., Koenig, C. H., Nichol, J. B., Kanter, D. B., & Young, N. A. (1971). *Handbook of precise behavior facts*. Kansas City, Kansas: Precision Media.
- Lindsley, O. R. (1990, October). *Sharing key Charts that taught us most over 25 years*. Keynote Presentation at the 9th International Precision Teaching Conference, Boston, MA.
- Lindsley, O. R. (1991a). Precision Teaching's unique legacy from B. F. Skinner. *Journal of Behavioral Education*, 1 (2), 253-266.
- Lindsley, O. R. (1991b). B. F. Skinner (1904-1990): Thank you, grandpa Fred! *Journal of Precision Teaching*, 8 (1), 5-11.
- Lindsley, O. R. (1991c). Skinner's impact on education. *Journal of Precision Teaching*, 8 (1), Spring, 58-60.
- Lindsley, O. R. (1991d). From technical jargon to plain English for application. *Journal of Applied Behavior Analysis*, 24, in press.
- Malott, R. W. (1991). Can the dead man's test change reinforcement to punishment? *The ABA Newsletter*, 14, (3), 9-10.
- Pavlov, I. P. (1927). *Conditioned reflexes* (G. V. Anrep, trans.). London: Oxford University Press.
- Skinner, B. F. (1938). *The behavior of organisms*. Englewood Cliffs, NJ: Prentice-Hall.
- Skinner, B. F. (1953). *Science and human behavior*. New York: Macmillan.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Skinner, B. F. (1983). *A matter of consequences*. New York: Alfred A. Knopf.
- Skinner, B. F. (1990). Can Psychology be a science of the mind?. *American Psychologist*, 45, 1206- 1210.