

8912  
2158

## **Studies in Behavior Therapy and Behavior Research Laboratory June 1953 - Jan 1965**

### **The beginning**

For my Harvard doctoral dissertation I chose working with dogs rather than pigeons because they seemed closer to my ultimate goal, people. When meeting with my advisor, Fred Skinner, to discuss the effects of total body irradiation and drugs on beagle dog discrimination and fear (Lindsley, 1957a), we always strayed from the topic. We wondered whether the catatonic schizophrenic standing in a corner all day was the result of total extinction. We wondered whether the hebephrenic was reinforced for giggling on a variable ratio schedule. If so, all we had to do was find a reinforcer and shape them back to their normal performance.

Fascinated, I promised Fred that if he could get funds, I would give human free operant research with psychotics five years of my life. If it didn't pan out my parachute plan was to go to Ringling Brothers Circus and shape Gargantua the gorilla to play a piano and simple card games. I ended up spending eleven and a half years studying psychotics from the back wards of Metropolitan State Hospital.

Skinner got support from the Milton Fund of Harvard and the U. S. Office of Naval Research. Harry Solomon, chair of Psychiatry at Harvard and Commissioner of Mental Health for Massachusetts agreed to serve as a co-investigator. I started in June 1953 with \$7,500 for the year in "A" Basement (an abandoned hydro therapy unit) of Metropolitan State Hospital, Waltham, Massachusetts. We studied both acute and chronic male and female psychotic patients, autistic children, and even violent patients from the locked wards (it was before routine drug therapy). We studied attendants, adult volunteers, and school children as normal controls.

### **Project Name Selection**

Skinner named our project "Experimental Analysis of the Behavior of Psychotic Patients" (Skinner, Solomon, & Lindsley, 1954). Hospital staff, patients, and parents reacted negatively to the words "Experimental Analysis." I made a list of 12 possible names and chose "Studies in Behavior Therapy." Market tests of the name with staff, patients, and family were positive. I liked the words because they meant we treated behavior problems with behavior. Skinner and Solomon approved this name for our project (Lindsley, Skinner, & Solomon, 1953, 1954a, 1954b). This was the first use of the name "Behavior Therapy."

After two years we were accepted as part of the hospital staff by patients and families. Our stationary and business cards were used up. We felt secure enough to change our name to "Harvard Medical School Behavior Research Laboratory" (Lindsley, Skinner, & Solomon, 1955). Strangers would read it in the telephone book and call up and ask, "Do you do laboratory research on behavior?" Mary Hall, our secretary, would laugh and answer, "Of course!" This was the first use of the name "Behavior Research."

### **Operandum Design**

Many chronic psychotic patients occasionally become highly destructive with no advance warning. They throw objects, smash chairs, and break windows. In order to record the behavior of such patients while in their destructive episodes, we needed indestructible rooms and signals (stimuli) and operating switches (operanda). The operanda had to be moved easily at frequencies above 300 per minute so there would be no ceiling on response frequency. No commercially available switches met these demands, so we designed and Ralph Gerbrands built, our "Lindsley Operandum." Other laboratories later purchased this operandum from Gerbrands, Inc.

### **Symptom recorders**

To record psychotic symptoms we used electrical mats on the floor to record

pacing, and voice operated relays hidden in the ceiling to record vocal hallucinating (talking and yelling to no one). These frequencies were recorded minute to minute on cumulative recorders with electrical counters for the hourly and daily totals. Three recorders ran throughout each session, a manual work recorder, a pacing recorder and a vocal hallucinating recorder (Lindsley, 1959, 1963a).

### **Reinforcer Search**

We designed and Gerbrands built universal magazines that would carry anything from a penny, an M&M candy, a cigarette, or a slice of apple, to a package of cigarettes, and deliver them rapidly down a chute into the experimental room. We never found adequate rewards for several of the patients (Lindsley, 1956a). In vain we tried projected 2 x 2 slides of various subjects, including nude women for the men. We tried various musical selections and movies, but the silent periods in the image and sound when the frequency of responding dropped disturbed the viewers.

### **Conjugate Reinforcers**

We designed and built the first conjugate reinforcer to continuously present narrative movies and music without the brief pauses that destroy narration and mood. The reward brings the image or sound louder, closer, or more in focus. The rate of response is directly linked to the intensity of the video or audio channel. The faster the patient presses one switch the louder the audio; the faster they press the other switch the brighter the projected image.

Conjugately reinforced loud noises penetrated sleep (Lindsley, 1957b), surgical anesthesia (Lindsley, Hobika, & Etsten, 1961), coma (Lindsley & Conran, 1962), and infancy (Lipsitt, Pederson, & Delucia, 1966), but still did not generate behavior from our most withdrawn chronic psychotics.

Conjugately reinforced television commercials were easily calibrated (Lindsley, 1962c), and closed circuit televised psychotherapy sessions were

easily analyzed (Lindsley, 1963b, 1969). The conjugate schedule is sensitive enough to record preference for stereo over monophonic music (Morgan & Lindsley, 1966). Over a hundred studies using the conjugate schedule have since been reviewed (Rovee-Collier & Gekoski, 1979).

### **Reinforcer Behavior Therapy**

We eliminated and reduced symptom frequencies in some patients with differential reward methods (Barrett, 1962; Lindsley, 1959). However, there were some patients for whom we never found a useful reinforcer.

### **Social Reinforcers**

In attempts to see if patients were too guilty to work to reward themselves, we tried giving them the opportunity to feed a hungry kitten as a reward (Lindsley, 1956b). We yoked two experimental rooms to see whether patients would work to reward a friend, attractive member of the opposite sex, or a stranger (Cohen, 1962; Cohen & Lindsley, 1964). We generated cooperation between children without giving instructions by using reward contingencies alone (Azrin & Lindsley, 1956). None of these attempts were effective with our most depressed inactive patients.

### **Simultaneous Discrimination and Differentiation**

One of the most powerful diagnostic methods was a panel with two signal lights. Each was lit for one minute as they switched back and forth. A lever under each light could be pulled singly or both at once. Pulling the left lever with the left light on was reinforced on a fixed-ratio 10 schedule (every tenth response rewarded) with a coin or candy. Pulling the left lever with the right light on, or the right lever with the left light on, or the right lever with the right light on was never reinforced. Each of these four reflexes was separately recorded on counters and cumulative response recorders. A fifth recorder continuously recorded simultaneous lever pulls (within 125 ms. of each other) which were never reinforced. (Barret & Lindsley, 1962).

Simultaneous learning to discriminate (tell the lights apart) and differentiate (tell the levers apart) could be seen developing on the five recorders. Learning deficits in nonverbal and violent patients were easily diagnosed and compared with the learning of normal children and adults (Lindsley, 1962).

### **Ten Year Data Histories**

Our core group of 50 male psychotic patients participated in our rooms at least one hour each weekday for as long as 10 years. Several patients had 25 to 29 day rhythms in their performance which we tried to relate to phases of the moon, sun spots, temperature fluctuations, but none of these held up. Patients whose 10 year histories were without rhythms were good for measuring drug effects because we could rule out mood swings, hospital events, and family visits.

### **Seven Hour Drug Sessions**

Since most psychotic episodes of hyper active shouting to no one and stereotyped pacing lasted from 15 to 45 minutes, we needed sessions as long as two hours to capture one from beginning to end. To record the onset and duration of an intramuscular injection of a drug our nurse entered the room after 15 minutes and injected the drug. 15 to 30 minutes after injection the drug usually had its onset effects. After about 5 hours the effects wore off. With these seven hour sessions we could record the full effect of an injection on a patient's work, pacing, and vocal symptoms (Lindsley, 1962b).

The immediate effects of the injected drug produced the same effects as did oral administration effects, which usually took weeks and months to develop and subside.

### **Coextensive Reflex Emission**

These seven hour sessions permitted us to view and quantify the interactions between episodes of vocalizing, manual working, and pacing. With 16 patients these episodes were independent. In 6 patients, all diagnosed schizophrenic, these episodes coextended over the same time interval. They appeared linked together or

alternated. All normal controls manually worked throughout the seven hours with no vocalizing and only a very few pacings. Except for the vocal hallucinating and pacing, this reflex coextension was the first emergent diagnostic item we found. All other diagnostic items that we found were deficiencies, a decrease or absence of normal performance.

### **Folly of Drug Screening**

Our seven hour intramuscular injection drug sessions predicted the response of patients to long term (3 months) oral administration of the same drug. This meant we could screen new drugs at the rate of one a week on ten psychotic patients. This screening efficiency appealed to drug companies and to the National Institute of Health. We had a screening device. We could screen one new drug a week on the normal work, pacing, and hallucinating of chronic and acute psychotic patients

We wondered what was the past success of scientists with screening devices in searching for effective compounds? How many drugs must we try before we would find one that would reduce psychotic symptoms and at the same time restore normal work performance? Edison said he screened 3,000 materials before he found the carbon filament for his electric bulb (Josephson, 1959). Marie Curie tried hundreds of salts, oxides, and ores before she found the radioactive pitchblend and chacolite (Pflaum, 1993). Salvarsan<sup>TM</sup> (arsphenamine), an early treatment for syphilis, was the 606th compound the company tried. The range seemed to be 3,000 to 300 attempts before screening success.

If we tried a new compound a week and were very lucky we might expect to find a psychotic treatment drug in 300 trials, or 6 years at the rate of one trial a week. The hooker was that the drug companies were only producing 5 to 10 per year that were clear of human toxicity. That would take 30 years if we were as lucky as Curie and 300 years if we had Edison's luck!

The kiss of death to our drug screening came in 1957 to 1962 when Thalidomide taken in even a single dose caused pregnant women to miscarry or give birth to horribly deformed children. The Thalidomide scare caused a shut down in new drugs approved by the United States Health Service for human trial. New drugs available for trial with psychotics went from 5 to 10 per year to 1 in 5 years. With those restrictions, if we were lucky we would find an effective drug in 5 x 300 or 1500 years! So ended our drug screening plans.

### **Lab Visitors**

Our laboratory guest book shows that in the twelve years from 1953 through 1964 ninety eight university classes from ten universities with a total of 1857 students spent day long field trips in our laboratory. Nine hundred thirty seven professionals visited our laboratory from the United States and over seventeen other countries.

Visiting psychiatrists and psychologists included Carl Rogers, Harry Harlow, Roy Menninger, Pierre Pichot, Paolo Nuzzi, Koji Sato, Hudson Hoagland, Otto Kernberg, Andey Snejnenski, Carl Pfaffman, Frank Beach, Donald Lindsley, Carl Pribram, Joe Zubin, and Tim Leary.

Visiting behavior analysts included Don Baer, Harold Weiner, William Morse, Ted Allyon, Dale Brethower, Matthew Israel, Charlie Catania, Thom Verhave, Joe Brady, and Charles Ferster. Sidney Bijou visited in April 1957, November 1961, and April 1962. Bijou built a similar laboratory for children at the University of Washington, as did Ferster at the University of Indiana Medical School, Azrin at Anna State Hospital in Southern Illinois, and Barrett at Fernald State School, Waltham, Massachusetts.

### **Research Trainees**

Undergraduate Honors theses were conducted by Larry Fane and Donald Cohen. Masters theses were conducted by Julie Rich and Barbara Morgan. Post Doctoral trainees were Nathan Azrin, Beatrice Barrett, Peter Nathan, Martha Mednick, and Paul Blachly. Tom Gilbert

conducted research in our laboratory while on a University of Georgia sabbatical.

### **Awards**

In 1962 the American Psychiatric Association awarded one of our research papers its annual Hofheimer Research Prize (Lindsley, 1960). In 1964 the American Academy of Achievement awarded us its Golden Plate Achievement Award. These twelve pioneering years were cited in two recent awards, the 1998 Thomas F. Gilbert Distinguished Professional Achievement Award from the International Society for Performance Improvement and the 1999 Award for Distinguished Service to Behavior Analysis from the Society for the Advancement of Behavior Analysis.

### **Appliers Abandon Frequency**

Most of the behavior analysts who visited our laboratory and then set up studies in clinics, hospitals and schools did not use rate of response as a behavior measure; they used percent. To me this was a crisis because we had proven that frequency was as much as 10 times more sensitive than percent. I considered rate of response and the cumulative self-recorder to be Skinner's greatest contributions, and both were discarded by the appliers. Azrin went so far as to say "suit the metric," which meant use a different measure for each behavior you work with. It may have been easier to do, but such a loss of measurement standards rules out real science which requires standard measures.

Application research grew like wildfire compared to behavioral laboratory research. The laboratories were expensive, hard to fund, and ignored by both clinicians and animal laboratory researchers. Behavior modification, behavior therapy, and applied behavior analysis were clearly going to dominate the field. Unfortunately they left behind behavior frequency and self charting, Skinner's most powerful discoveries.

The crisis was clear. If something was not done soon, frequency and self charting would die with Skinner!

A few began to apply operant methods to regular and special education. They too did not use frequency or self charting. They said teachers preferred percent correct, and percent time on task. They said teachers were dead set against student self charting. Clearly education was a larger industry with far greater market potential than mental health.

Since I could not convince others to do it, I realized that I would have to put frequency and self charting into school classrooms. The combination of too few new drugs to try, increased university overhead charges, increased competition for smaller and smaller government research grants, lack of interest in our results, and the crisis of losing frequency and self charting to multiplying applications made continuing our laboratory research a poor choice.

In January 1965, I closed our laboratory and parachuted further into teacher education at the University of Kansas Medical Center than the percent correct applicators had yet gone. My mission was to get teachers using frequency and students charting their own performance. There we developed Precision Teaching and the Standard Celeration Chart used by students as young as five years to self chart their learning and make their own improvement decisions (Lindsley 1972, 1996, 1997). But that's another story.

## References

- Azrin, N. H., & Lindsley, O. R. (1956). The reinforcement of cooperation between children. *Journal of Abnormal and Social Psychology, 52*, 100-102.
- Cohen, D. J. (1962). Justin and his peers: An experimental analysis of a child's social world. *Child Development, 33*, 697-0717.
- 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.
- Barrett, B. H. (1962). Reduction in rate of multiple tics by free operant conditioning methods. *Journal of Nervous and Mental Disease, 135*, 187-195.
- 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.
- Josephson, M. (1959). *Edison: A biography*. New York: McGraw-Hill. page 207.
- Lindsley, O. R. (1956a). Operant conditioning methods applied to research in chronic schizophrenia. *Psychiatric Research Reports, 5*, pp.118-139.
- Lindsley, O. R. (1956b). Feeding a kitten - a social reinforcer. In annual technical report #3, November, Contract N5-Ori-07662, Office of Naval Research. Waltham MA: Harvard Medical School, Behavior Research laboratory.
- Lindsley, O. R. (1957a). *Conditioned suppression of behavior in the dog and some sodium pentobarbital effects*. Unpublished doctoral dissertation, Harvard University.
- Lindsley, O. R. (1957b). Operant behavior during sleep: A measure of depth of sleep. *Science, 126*, 1290-1292.
- Lindsley, O. R. (1959). Reduction in rate of vocal psychotic symptoms by differential positive reinforcement. *Journal of the Experimental Analysis of Behavior, 2*, 269.
- Lindsley, O. R. (1960). Characteristics of the behavior of chronic psychotics as revealed by free-operant conditioning methods. *Diseases of the Nervous System, Monograph supplement, 21*, 66-78.
- Lindsley, O. R. (1962a). Operant conditioning methods in diagnosis. In J. H. Nodine & J. H. Moyer (Eds.), *Psychosomatic medicine: The*

- first Hahnemann symposium* (pp. 41-54), Philadelphia: Lea & Febiger.
- Lindsley, O. R. (1962b). Operant conditioning techniques in the measurement of psychopharmacologic response. In J. H. Nodine & J. H. Moyer (Eds.), *Psychosomatic medicine: The first Hahnemann symposium* (pp. 373-383), Philadelphia: Lea & Febiger.
- Lindsley, O. R. (1962c). A behavioral measure of television viewing. *Journal of Advertising Research*, 2, 2-12.
- Lindsley, O. R. (1963a). Direct measurement and functional definition of vocal hallucinatory symptoms. *Journal of Nervous and Mental Disease*, 136, 3, 293-297.
- Lindsley, O. R. (1963b). Free-operant conditioning and psychotherapy. In J. H. Masserman (Ed.), *Current psychiatric therapies*, Vol. 3, (pp. 47-56). New York: Grune and Stratton.
- Lindsley, O. R. (1969). Direct behavioral analysis of psychotherapy sessions by conjugately programmed closed-circuit television. *Psychotherapy: Theory, Research, and Practice*, 6, 71-81.
- Lindsley, O. R. (1972). From Skinner to Precision Teaching: The child knows best. In J. B. Jordan & L. S. Robbins (Eds.), *Let's try doing something else kind of thing: Behavioral principles and the exceptional child* (pp. 1-11). Arlington, VA: Council for Exceptional Children.
- Lindsley, O. R. (1996). Is fluency free-operant response-response chaining? *The Behavior Analyst*, 19(2), 211-224.
- Lindsley, O. R. (1997). Precise instructional design.: Guidelines from Precision Teaching. In C. R. Dills & A. J. Romiszowski (Eds), *Instructional development paradigms* (pp. 537-554). Englewood Cliffs, NJ: Educational Technology Publications.
- Lindsley, O. R. & Conran, P. (1962). Operant behavior during EST: A measure of depth of coma. *Diseases of the Nervous System*, 23, 407-409.
- Lindsley, O. R., Hobika, J. H., & Etsten, B. E. (1961). Operant behavior during anesthesia recovery: A continuous and objective method. *Anesthesiology*, 22, 937-946.
- Lindsley, O. R., & Skinner, B. F. (1954). A method for the experimental analysis of the behavior of psychotic patients. *American Psychologist*, 9, 419-420.
- Lindsley, O. R., Skinner, B. F., & Solomon, H. C. (1953). Study of psychotic behavior, Studies in Behavior Therapy, Harvard Medical School, Department of Psychiatry, Metropolitan State Hospital, Waltham, MA, Office of Naval Research Contract N5-ori-07662, Status Report I, 1 June 1953 - 31 December 1953.
- Lindsley, O. R., Skinner, B. F., & Solomon, H. C. (1954a). Study of psychotic behavior, Studies in Behavior Therapy, Harvard Medical School, Department of Psychiatry, Metropolitan State Hospital, Waltham, MA, Office of Naval Research Contract N5-ori-07662, Status Report II, 1 January 1954 - 31 May 1954.
- Lindsley, O. R., Skinner, B. F., & Solomon, H. C. (1954b). Study of psychotic behavior, Studies in Behavior Therapy, Harvard Medical School, Department of Psychiatry, Metropolitan State Hospital, Waltham, MA, Office of Naval Research Contract N5-ori-07662, Status Report III, 1 June 1954 - 31 December 1954.
- Lindsley, O. R., Skinner, B. F., & Solomon, H. C. (1955). Study of psychotic behavior, Behavior Research Laboratory, Harvard Medical School, Department of Psychiatry, Metropolitan State Hospital, Waltham, MA, Office of Naval Research Contract N5-ori-07662, Status Report IV, 1 January 1955 - 31 August 1955.
- Lipsitt, L., Pederson, L. J. & Delucia, C. A. (1966). Conjugate reinforcement of operant responding in infants. *Psychonomic Science*, 4, 67-68.
- Morgan, B., & Lindsley, O. R. (1966). Operant preference for stereophonic over monophonic music. *Journal of Music Therapy*, 3, 135-143.
- Pflaum, R. (1993). *Marie Curie and Her Daughter Irene*. Minneapolis: Lerner Publications
- Rovee-Collier, C. K., & Gekoski, M. J. (1979). The economics of infancy: A review of conjugate reinforcement. *Advances in Child Development*, 13, 195-255.
- Skinner, B. F., Solomon, H. C., & Lindsley, O. R. (1954). A new method for the experimental analysis of the behavior of psychotic patients. *Journal of Nervous and Mental Disease*, 120, 5, 403-406.