Rate of Response Futures

Ogden R. Lindsley, Ph.D.

University of Kansas

RUNNING HEAD: Rate of Response Futures

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Introduction

I'd like to start with when I first became convinced to commit myself to rate of response, not just operant rate. There were three things that did it:

THREE MAJOR FACTORS IN MY FREE OPERANT COMMITMENT OF SPRING 1951:

(1) SAMSON RAT -- LIFTED 250% BODY WEIGHT IN THREE WEEKS.

(2) RATE IS A UNIVERSAL DATUM.

(3) THE RAT KNOWS BEST.

One was Samson rat, who lifted 250% of his own body weight in three weeks. And he taught me how to teach him to do that when I was watching his rate, not his muscles, not his latency, not his duration, not his defecation, not his spinal erection, just how often he pushed the lever. So by watching rate I increased quality.

The other thing is a statement that one B.F. Skinner, who was my teacher, said rate is a universal datum. Having been a World War Two flight engineer, an undergraduate engineer, you are well aware of Maxwell's equations, the frequency of light, the frequency of sound, and the huge steps forward that mankind has made whenever he's expressed something with qualitative differences on a frequency spectrum and ignored it then he was able to create one that nature couldn't even come close to, but you had to forget red, blue, and green, and think 880 millimicrons. That impressed me: The possibility of putting behavior on a spectrum and having the same skills that we've done with sound, light, and electromagnetic waves.

The last one is "The rat knows best." And this was the first time that I had come up against scientific induction in practice. I once went to, but Fred has probably forgotten, with a chart of cumulative records of a rat behaving the way Ogden required the rat should not be behaving. And I thought it was a challenge. "What, what about this, Dr. Skinner?" And he said, "Well, you know, the rat knows best. That's why we had him in the experiment." And I've always thought that made sense.

Continuing Commitment

Now, I'd like to share a couple of things that have since 1951 when I committed myself to rate that have convinced me more and more that the commitment should continue. One is I became interested in schizophrenics, and the only other person who had worked long with schizophrenics was Pavlov, who dropped dead 12 years into a 25 year experiment at the age of 86. I learned Russian and read esoteric Pavlovian things, thinking maybe he had found out something about schizophrenics that would help me. In Conditioned Reflexes, translated by Azaroth {sp?}, I was amazed to find out that Pavlov had not watched amplitude as Hull had implied, but Pavlov had watched frequency on an event recorder. What Pavlov watched was he would put on a conditioned stimulus, "Bmmmmmmm," and with Pavlov watching, "mmm {HIT} mmmm {HIT} mmmmm {HIT} mmmm {HIT} mmmmm {HIT} mmmm." {[Lindsley was tapping the microphone, while making the 'm' sounds]} Then, he'd turn off the conditioned stimulus and put on the unconditioned stimulus, dropping some food powder {HIT, HIT, HIT, HIT [Lindsley was tapping the microphone]}. That intermittent meshing of the frequency of behavior, that study is I think what instructs mankind about himself. So. So, I just thought, if frequency was good enough for Pavlov, and good enough for Skinner, it's good enough for me.

Some of you, I think, thought, some of you've been told, "don't use rate, use amplitude." Hull didn't even know that, so he put cc's in Principles of Behavior as an example of response amplitude. If we put on a standard chart; a standard frequency on the left chart, where we have celeration across the chart:

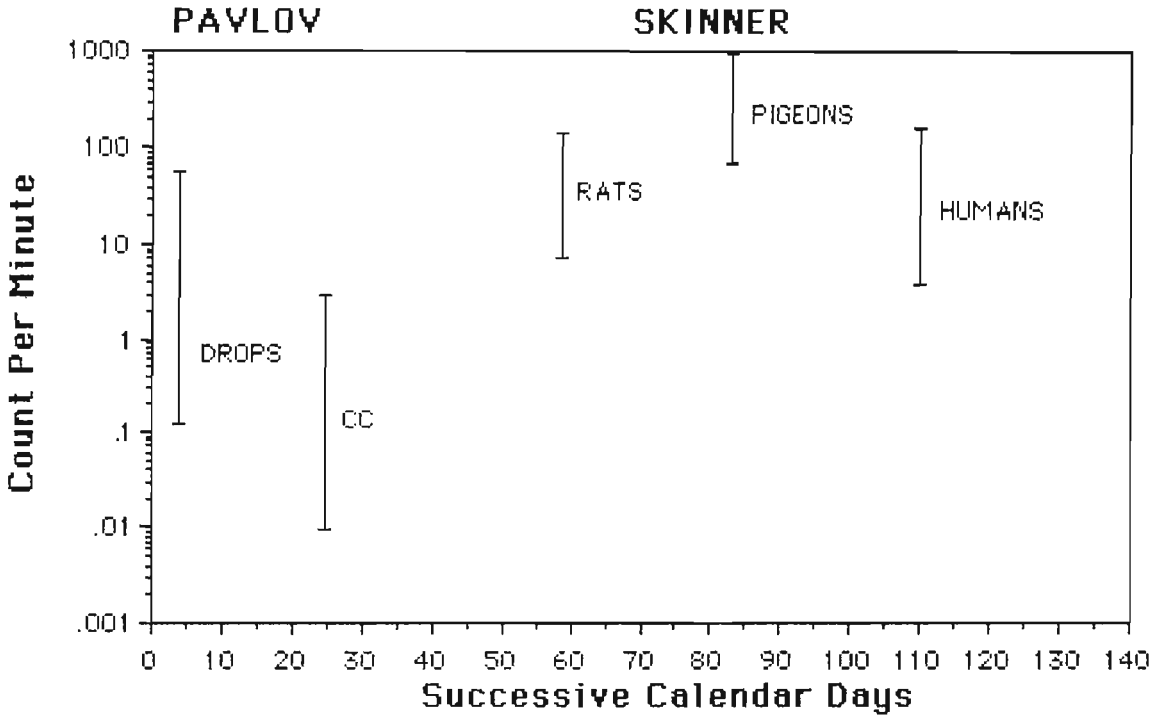


Figure 1. Frequency ranges.

If Pavlov had watched cubic centimeters--he had a machine that went after one start it would go "glunk . . . unk," he would have been looking at things about one every five minutes for a mean. If he watches drops his median observation frequency is 10 a minute of those, which is pretty good. Once every six seconds he has something to pay attention to. The range of behavior of rats--they behave more slowly--the kind of range to work with is 10 to, say, 100.

People wonder why Skinner switched from rats to pigeons. No one really knows, because it has to do with the fact that he was at Minneapolis, and General Mills was at Minneapolis, and General Mills has grain bins, and pigeons hang around grain bins, in World War Two. All these things sort of give you it. If you arrange an environment with which he had the idea that pigeons might guide missiles. And what that gets you, but why do you stay with pigeons? When your observation frequency is X10. You have 10 times the opportunity to discover; they put out 10 times faster. It might be that's why people who have worked with pigeons very seldom go back to rats, unless they're more turned on by rodents than they are

discoveries.

Now there's another interesting thing: Human frequencies are a little slower than avian and a little more like rats, between say five and 120 a minute. So, if you kind of get the idea that if you're going to watch a phenomenon it should be in your range. And I think that's why these people are successful. It's easy to pay attention to something that goes "bump, blup, ... blup, bl, bl, bu," because that's in your range. And the trick is to get the thing you're interested in in the range of your sensitivity. That's just a hunch.

Now, I'd like to share some other data fast. And I'll use a standard celeration chart. Some of you are familiar and some of you are not. How many people are familiar with this chart? Hands up please. Look, if you don't know and have a question, ask someone with a hand up. There are three things on the chart. Pavlov had a standard self-recording system, which was a kymograph or event recorder:

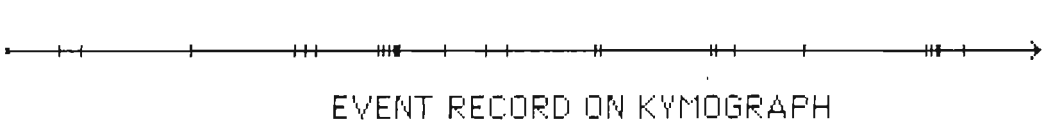


Figure 2. Pavlov recorded rate of behavior.

Skinner improved on that by having the pen move up the paper. In fact, the very first ones were actually kymographs, and the first one went up the paper the wrong way, and he later reversed it. So Skinner put cumulative responses up the left and time across the bottom:

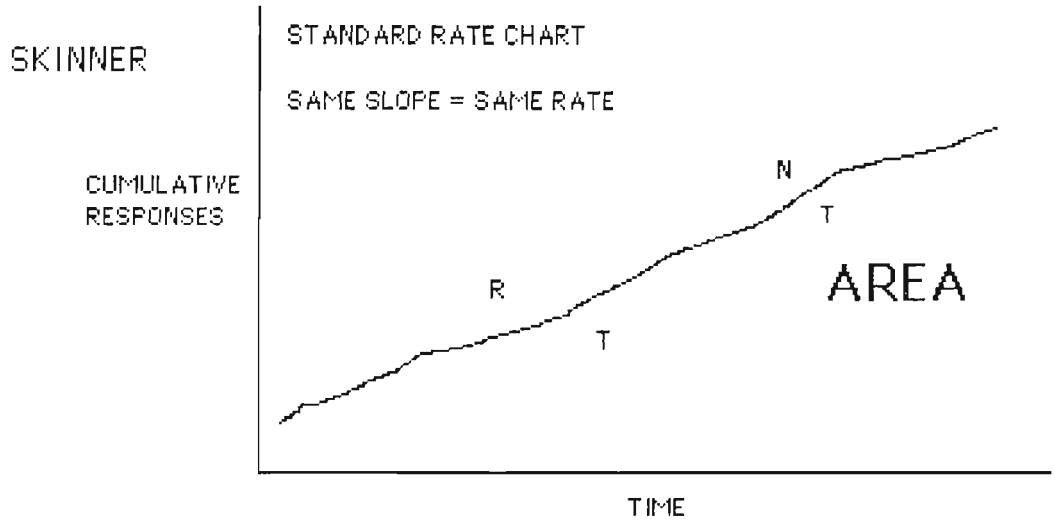


Figure 3. The standard rate chart (cumulative record).

And the slope of that chart is responses versus time or number versus time. So it really should have been called a **standard rate chart**. All things on that chart that have the same angle have the same rate. He named it for its ordinate. He did not name it for its slope.

If we take the standard rate, if we take the slope of the cumulative response recorder, and put it on the left of the chart, thereby going to the next derivative, we now put number per time on the left and time across the bottom.

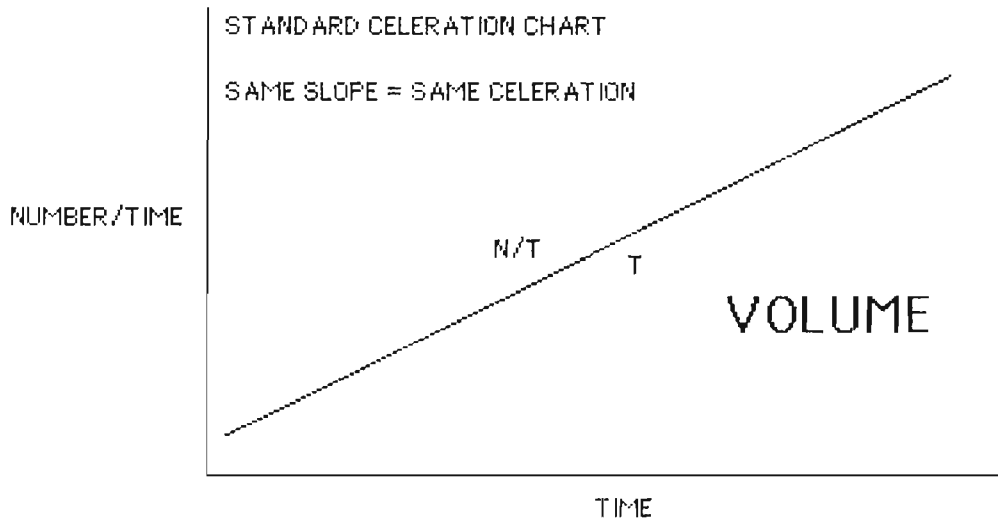


Figure 4. The standard celeration chart.

The slope of that chart {the cumulative record} becomes change in rate or number per time per time. Rate has two dimensions. Celeration, or change in rate, has three dimensions. This {standard rate chart} is **area**. This {standard celeration chart} is **volume.**

So, I'll give you a little example. People think duration is not rate. Duration really is rate. It's the rate of one. One big one. The rate of one: One maze run in 30 minutes. One divided by 30. Here's Thorndike's duration data, which is used as a duration measure for Hull, charted on a standard celeration chart. And we see some interesting things. We see that it has three directly observable properties. It has a beginning point, and an ending point. Those are the frequencies. It began at one per minute and ended up about five per minute escapes. It has some variability. That we call the "bounce." That's the influence of other variables each day.

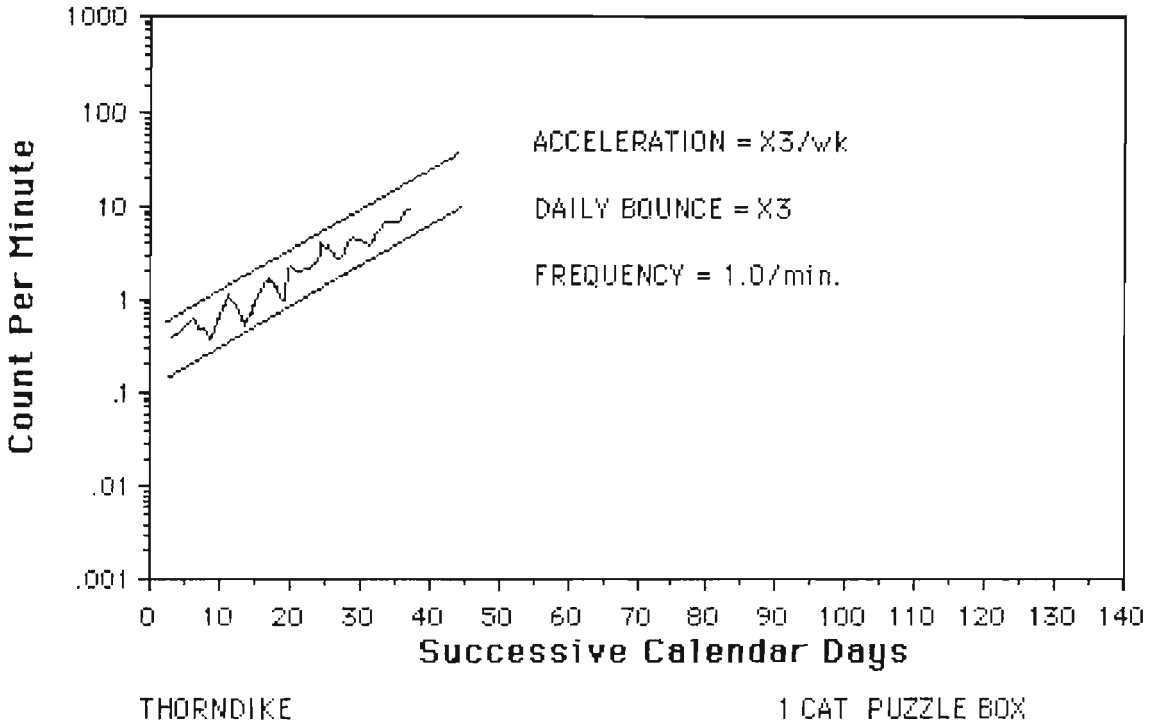


Figure 5. Thorndike data. {Note: Figure is an approximation of the figure that was presented by Lindsley}.

The bounce is X3. And it has a slope, which is the number per time per time, which we call acceleration if it's going up, deceleration if it's going down. It's tripling every week, an acceleration factor of X3. These are the three things we'll be looking at in some of the charts I want to share with you a little further. I think it's very nice to see, to be able to go back and look at 1911 data and see it so clearly.

Hull's Measures Are Actually Rate

Now, to Hull. I have discovered just recently, since I'm preparing a paper for the American Psychology Association on 100 years of learning, prepared on standard celeration charts, to find out whether Ebbinghaus or Pavlov produced the biggest behavior change, I got into Hull. And it just, after having been there before, it hit me like a ton of bricks that Hull was a

politician, for he put in something for everyone:

HULL -- BEHAVIORAL POLITICIAN

REINFORCEMENT.....	ANIMAL LEARNERS
GENERALIZATION.....	SENSORY PSYCHOLOGISTS
MOTIVATION.....	PHYSIOLOGICAL PSYCHOLOGISTS
INHIBITION.....	LEARNING THEORISTS
OSCILLATION.....	STATISTICIANS
RESPONSE INCLINATION.....	ANYONE ELSE

He had reinforcement for an intervening variable for the animal learners; generalization for the sensory psychologists; motivation for the physiological; inhibition for the learning theorists; oscillation for the statisticians! And response inclination for anybody he missed!

He was equally political in the measurement of behavior. His dependent variables were percent, amplitude, trials to extinction, and latency. Had he know of {tape unclear} and {tape unclear} he'd have time sampling.

HULL

P	% PROBABILITY	RATIO OF TWO RATES.
A	AMPLITUDE	PAVLOV'S CC/MIN.
T	TRIALS TO EXTINCTION	MUST HOLD TIME CONSTANT.
S^{R+}	LATENCY	FREQUENCY OF FIRST ONE.

Now, we all know that percent as Don {Baer} has just told us is a comparison of two rates. So, I need to put two lines on the chart and you've got percent. Amplitude is Pavlov's cc per minute, which is just a translation error. Trials to extinction: We must hold time constant so it's number over time--that's how you must record the term. And latency is the frequency of the first one. Duration is the frequency of them all.

And you could, if anybody want to measure finer and finer things, and most or many of these people are motivated not by discovery, but by breaking things into the smallest pieces. Sometimes I think you can predict this kind of scientist by what he did with an 8 & 1/2 by 11 piece of paper with nothing on it. If it ended up in 400 pieces, he's a reductionist. If he folded it and threw it across the room, he's not a reductionist, he's a functionalist. I would advise anybody who's a reductionist, there's a lot of {tape not clear here}. You could have the latency of the middle five. You could have the frequency of the middle five. Frequency of the first one, frequency of the second one, frequency of the third one. Out of 100 responses you can get 100 different frequencies. So this is really, you see, a something-for-everyone approach, which can be reduced through to a standard thing that you like.

I'd like to share now some things that have happened since 1951. I have been committed to frequency, and since 1953 to human behavior frequency. First, something we found out was that frequencies grow by straight lines on a multiply-divide chart. We built the standard frequency spectrum, and it had to be logarithmic in order to get something from one a day to a hundred per minute all on one page. That's why we built the chart. What we found out was that we could predict learning from the chart.

Two days is not enough to predict learning. One week is not enough to predict learning. Two weeks gets you about 80% of the children. So we can put frequency on a standard celeration chart to predict behavior. Predict two weeks from two weeks.

Another thing we found out was we stored in a computer 30 or 40 thousand behavior modification projects, including all those that had been published up to 1973 in all of the journals. And we broke them into 17 frequency categories. And we put the median or geometric mean celeration down for each of the 17 frequency categories from one a day to three or four hundred a minute.

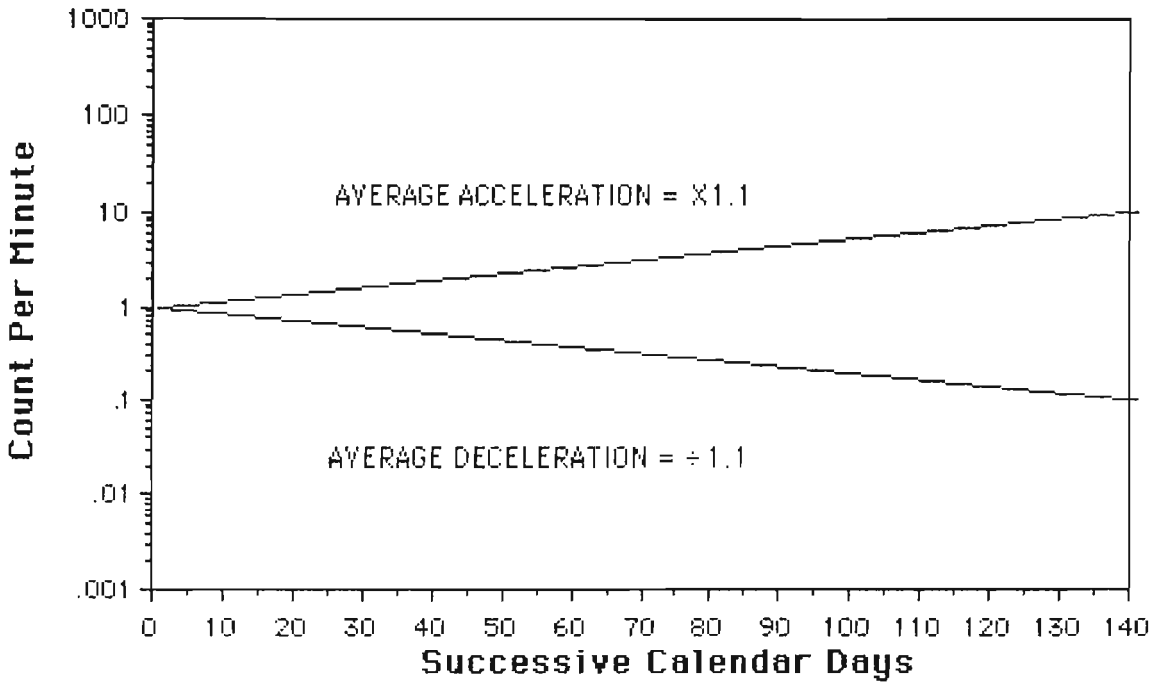


Figure 6. Average acceleration and average deceleration.

The number of projects in each--it's very hard to get high frequency behavior, it's very hard to get rid of them--the average acceleration is X1.1. The average deceleration is ÷1.1. That's a 10 percent per week increase, 10 percent per week decrease. And this proves that celeration is independent of frequency.

Also bounce. If we put the bounce of each one of these frequency cells: Bounce is independent of frequency and is around X3 or X4, as was shown in Thorndike's 1911 data.

Now, one other thing that is more important to us. This shows that with using standard measures and collecting enough data you can emerge behavioral laws inductively. We expected frequency to be related to celeration. I thought the higher the behavior the easier it would be to change. But, not true.

Comparing Treatments on Standard Charts

Now, let's look at animal punishment data, on stretch-to-fill-you-need charts. Tell you neighbor, who has the biggest punishing effect, Azrin, or Kelleher and Morse? Azrin with pigeons, Kelleher and Morse with squirrel monkeys. Time's up.

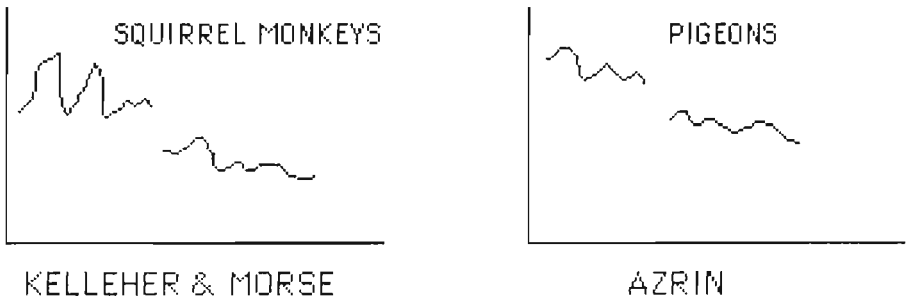


Figure 7. Data on stretch-to-fill charts.

These are standard celeration charts. On the left is Kelleher and Morse with the squirrel monkey. On the right is Azrin with a pigeon.

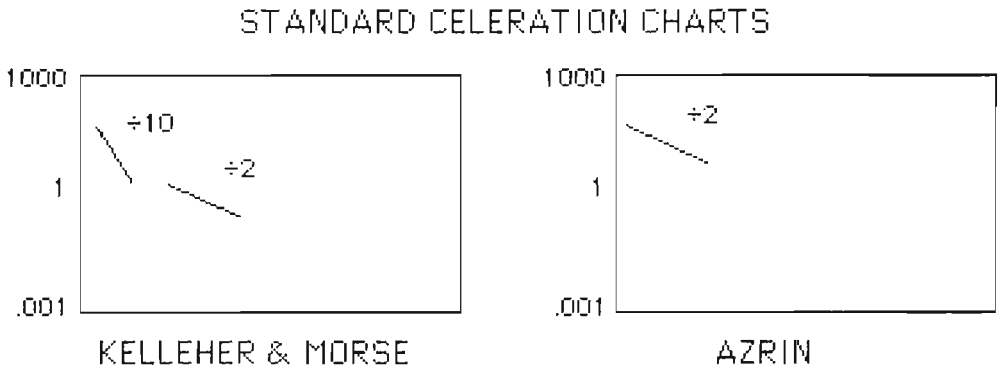


Figure 8. Data re-plotted on standard celeration charts.

Which has the greatest deceleration effect of punishment? Very quick, Kelleher and Morse is divide by 10 immediate, Azrin divide by two. Notice, the interesting thing is the second time Kelleher and Morse do the punishment they get an effect very similar to Azrin's first time.

Which leads me to believe that this chart isn't Azrin's first time with this pigeon. It's very nice to have an overlay and the charts are all together. The second time is divide by 10. I don't want to get into this too much. I'm just showing you how things become clearer when you look at them through standard charts.

Now, let's look at behavior modification punishment. Here is Brasner and Stein, effect of shock on aggressive behavior. Here's Kobol and Kobol, the effect of nose slap on self stim of an autistic kid. Whisper to you neighbor which one has the biggest effect. Now, let's really do it. Which effect is bigger? Well, maybe that's hard. Let's put on some more. Now you're in the job of ranking treatments. Here comes Kantor and Zoler, the slaps on fact and the effect is ammonium under the procedures of {tape unclear here}. Here's the effect of overcorrection on copraphagy. And here's the effect of lemon juice on rumination. "All right Supervisor of Treatment, which one was the biggest effect of behavior correction?" {Transcriber's note: Each graph that Lindsley presented was a unique "stretch-to-fill" chart, and it was impossible to make comparisons}.

The standard celeration chart would help a bit. Here's the effect of shock on aggression. Here's the effect of nose slap on autistic self stim. Here's the effect of ammonium on slaps on face. Here's the effect of overcorrection on copraphagy. And here's the effect of lemon juice on rumination. Now, if you want to put numbers on that the amount of the first effect is a frequency divider. So we measure that distance, and then if there's an effect on the frequency on the celeration. You either can have two effects: You can have a frequency shift or a celeration change. You can change the speed at which he does it, or you can cause him to do it less and less or more and more.

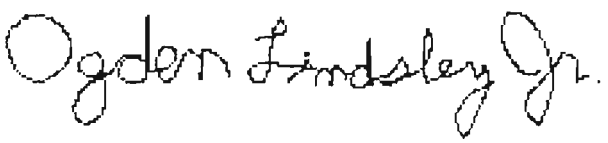
The summary of those charts is the most powerful effect was shock with a frequency of ÷150, no effect on celeration {tape unclear here}. Divide by 30 for nose slap on self stim (Kobol and Kobol). Divide by 10 frequency plus divide by 12 celeration--you slap the behavior down and it lets the behavior down further--Kantor and Zoler. Foxx and Martin, divide by 10 overcorrection. Lemon juice and rumination is divide by three frequency shift, divide by two celeration change. I think that these summaries show that a standard chart might be of some value

in helping to compare treatments and decide which treatments have the most power for the most people.

A Mystic Experience and Frequency Regression

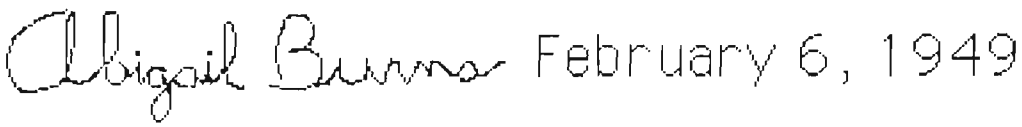
Now, the last thing is a mystic experience that I'd like to share with you. And I'm showing you this for two reasons: {1} If you get using standard celeration charts you don't have to pay attention to them and them alone. {2} But you do use them when you want to compare two or three different things.

On the 12th of January, 1978 I woke up early. And I thought "I'm telling everyone to try more than one thing." And since 1951 I have been trying to accelerate frequency of response or rate of response. I have not tried to decelerate. Ogden! {hitting his head} Dumb, dumb, Ogden! Decelerate something! Well, there wasn't anything around that I wanted to decelerate. So, I said maybe I'll try to write my signature as slowly as possible. I sat down at the kitchen table and wrote "Ogden Lindsley" at a frequency of 13 cursive letters in five minutes, or 2.6 per minute. And when I got about into "n" the hair stood up on my back. I had written my elementary school signature for the first time in 50 years. I thought "Jesus no, that can't be!" So, I called my mother, and she got ahold of all my old schoolbooks. Yes. She had one and I was horror struck because I'd written "Yale! Yale! Yale!" And I'd drawn a Harvard banner with holes in it! See. And then on the next page I had drawn a lot of things with big noses and people smoking. And I had put "Harvard blah! Yale, rah, rah, yea!!!" So, I guess I wanted to go to Yale in the first grade. But notice that I had written:



my dad was still alive. And "Oh my God, it can't be!" So I had an appointment with my dearest student who just received her doctorate, Abigail Burns Calkin. And I said, "Ab, write your name as slowly as you can in cursive." And she wrote

"And after you do that write as fast as you can so you can compare the two signatures." This is one minute writing as fast as you can. She wrote 4.2 per minute as slow as she can, 171 a minute rapid signature. I said, "Have you got any school papers?" And she wrote home to Maine and her mother sent her:



There it is. {The two signatures, the one from 1949 and the slow one from 1978 matched}.

So, if someone in hypnosis uses mystic experience to impress on you the power of hypnosis, tell him, "Got a pencil?" {Audience laughter} "Write you name as slowly as you can." Watch him squirm! He might even buy a cumulative recorder!

Here's the frequencies of slow as you can, fast as you can. About 175 a minute faster than slow. All agree that the fastest is the easiest. All agree here--these are grad students--they've seen the slowest before as their elementary signature. Here's 18 teachers at a student teacher workshop. Same thing. There's more belief when you do small N's and lump 'em than you do with giant N's (alone). Shows you can get the effect with 10 or more people. Same effect with a class in individual instruction. Same effect with another class. So, the end result is 60 to 70% of the people say they've seen the signature before. And so you can regress 60 to 70 to 80% of the people by drawing out the appropriate rate. The behavior is still there, stored under its rate address.

Summary

I would like to summarize: {In the following summary, the lines in capital letters are copied from the overhead transparencies that Lindsley presented--which he also read.}:

SUMMARY

BOTH PAVLOV AND SKINNER WATCHED RATE ON STANDARD SELF-RECORDERS.

ALL 4 (mnemonic PANT, for Percent, Amplitude, Number of trials, Time intervals) OF HULL'S RESPONSE MEASURES ARE ACTUALLY RATE.

A BEHAVIOR FREQUENCY SPECTRUM HELPS DISCOVER AND DISPLAY BASIC BEHAVIORAL LAWS.

STANDARD CELERATION CHARTS MAKE IT EASY TO DIRECTLY COMPARE THE POWER OF INTERVENTION AND TREATMENT METHODS.

(And the last one which is 1978):

IF YOU CHANGE THE FREQUENCY YOU CHANGE THE BEHAVIOR. FREQUENCY OR RATE REGRESSION IS POSSIBLE. A BEHAVIOR THAT HAS NOT BEEN EMITTED IN 30 TO 50 YEARS WILL RE-APPEAR. THEREFORE, FREQUENCY MUST BE A DIMENSION OFBEHAVIOR NOT JUST AN INTERLUDE.

I have alternate future conclusion number one (and two):

ALTERNATE FUTURE CONCLUSION #1

IN THE HANDS OF BEHAVIORISTS WHOSE REINFORCERS ARE LISTENER AND READER APPROVAL OF THEIR DATA, RATE WILL CONTINUE TO BE REPLACED BY STRETCH-TO-FILL CHARTS OF HULL'S FOUR MEASURES. THIS WILL FALSELY MAGNIFY TREATMENT POWER, SIMILARITY, AND GENERALITY.

ALTERNATE FUTURE CONCLUSION #2

IN THE HANDS OF BEHAVIORISTS WHOSE REINFORCERS ARE DISCOVERING AND ACTIVELY COMPARING INTERVENTION AND TREATMENT DIFFERENCES THE CHARTING OF RATE ON STANDARD CELERATION CHARTS OR CUMULATIVE RECORDERS WILL ACCELERATE. THIS WILL ACTIVELY DISPLAY PERSONAL AND TREATMENT DIFFERENCES AND MAKE CUSTOM-TAILORING AND COST COMPARING OF TREATMENT PROCEDURES.

You have the choice. Thank you.

---END OF PRESENTATION---

Reference to use when referring to the above paper:

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Transcriber Notes:

Transcribed by John W. Eshleman, Ed.D. in 1979. (Note: I attended the presentation. All charts shown in this transcript are from my notes that I took, and are approximations only to the original charts that Lindsley displayed. Various transcription conventions have been adopted throughout the document. All effort has been taken to ensure that the transcript is as close as possible to the audiotape of the session.

The text of Lindsley's talk is in Times 12 point font. Transcriber notes embedded in the text (to enhance clarity or make note of some other point) are in `Monaco 9 point font.`