Parameters of Pupil Freedom 25 Years Later
Identifying and Removing Ceilings on Learners’ Performance
ABA 2001 – New Orleans

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ABA 2001
Check our Web Site for Articles, References, etc.

Background
Description and Origins of the Four Ceilings
25 Years of Application and Refinement
What’s the Issue? “Discrete Trials vs. Free Operants”
Discussion

An Inspiration for Liberating Students

“Children are not retarded. Only their behavior in average environments is sometimes retarded. In fact, it is modern science’s ability to design suitable environments for these children that is retarded....The purpose of this paper is to suggest techniques... for maximizing the behavioral efficiency of exceptional children who show deficits when forced to behave in average environments. These suggestions evolved from the methods and discoveries of free-operant conditioning.”

R. Lindsley, 1964
Retarded Behavior, Journal of Education

Overview of The Four Ceilings

- Working with severely and profoundly disabled learners, we began to apply Precision Teaching methods.
- Because we were using discrete trials procedures...
  - We decided to measure count per minute in discrete trials.
  - We found Measurement-defined and Teacher-imposed ceilings.
- Removing Teacher-imposed Ceilings...
  - We found Deficit-imposed and Handicap-defined ceilings.
- Providing practice to remove Deficit-imposed Ceilings...
  - We enabled learners to surpass previous performance limits, accelerate new learning and achieve fluent application.

This Progression of Discovery repeats itself in many PT classrooms.

We used the term “ceiling” after watching charted student performance flatten out below what was required for efficient, competent application of skills.
1. Measurement-Defined Ceilings

"When only a percentage correct scale is used to measure skill performance... that is, when the time dimension is ignored... it is impossible to distinguish among various levels of skill proficiency.

When we fail to measure along the time dimension, we impose a serious constraint on our expectations for handicapped students, as well as on the likelihood that we will work to "normalize" their skill proficiencies."

Carl Binder
Data-Sharing Newsletter, Sept. 1978
Behavior Prostheses Laboratory

100% Correct: As Good as It Gets?

?? "Overlearning" ??

Percentage correct is NOT a measure of performance.
It is a dimensionless quantity?

The Same Accuracy Can Occur with Different Performance Patterns and Levels.

With percent correct you can't tell the differences among all these different Learning Pictures!

Removing Measurement-Defined Ceilings

Count and time performance - even in discrete trials.

Some Tactics:
- Use fixed-time sessions rather than a fixed number of trials
- If discrete trials are necessary, chart timed "probes" before and after teaching sessions, and free the teacher to teach.

Example (if discrete trials are necessary):
1. 1-minute pre-teaching probe (count corrects, errors, skips)
2. 5-minute teaching procedure with prompting, fading, correction procedures, etc. (but no recording, unless necessary)
3. 1-minute post-teaching probe (count corrects, errors, skips)

(Use pre-teaching probes to make phase-change decisions.)

Notice whether your procedure slows down the student.
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What We Observed when We Removed Teacher-imposed Ceilings

- Performance jumped up simply by changing materials (x2.0 to x5.0 is typical).
- Students with histories of highly controlled discrete trials often had to learn to "keep going."
- Teachers more easily applied principles of operant conditioning – using Skinner’s rate of response measure.
- "Problem" behaviors often decelerated or disappeared when we switched from trials to continuous performance.
- Students had more fun, expressed more positive feelings.

Tactics for Removing Teacher-imposed Ceilings

- Fade procedures and materials from one-at-a-time, to arrays or clusters of items, often to worksheets.
- Move from discrete to continuous imitation.
- Leave materials in left-to-right arrays, then use pointing cues to move students along.
- Focus on behavior components that students practice repeatedly with many more sets of materials.
- Prompt and reinforce "keep going" to build continuous behavior in students with histories of heavy consequences. ("Coaching & Cheerleading.")
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Like a Ton of Bricks It Hit Us!
...how severely we had handicapped our students by limiting their performance frequencies.
...that our trials procedures had little or no relationship with "real world" performance frequencies.
...how much we needed to dramatically revamp our materials and teaching procedures.
...that this frequency-based approach offered an extraordinary opportunity....
...because it allowed us to better understand and improve proficiency.

Isn't this WAY more interesting than percentage correct??

Endurance
"There is mounting evidence to suggest that endurance, or the ability to maintain a relatively high proportion of beginning skill performance frequency over increasing session durations, is a function of beginning frequency (proficiency level). In other words, high proficiency produces maximum endurance, in addition to facilitating application of skills.... In some cases, we use relatively short timings (e.g., 15 seconds or 30 seconds) in order to obtain maximum performance levels and prevent students from settling into low frequencies -- especially when we first work with a given student."

Carl Binder
Datasharing Newsletter, July, 1980
Behavior Prosthesis Laboratory

Diminishing Returns - an Endurance Aim

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Distractibility in a continuous performance --

Using What We Know about Endurance

In the beginning, many brief practices are better than a few long ones for producing learning.

10 or 15-second "sprints" are best in the beginning with many learners.

3. Deficit-imposed Ceilings

"Once we allow students to work at their own rates, we repeatedly observe that after an initial jump in proficiency, they often become 'flat liners' and fail to accelerate to within normal frequency ranges for many skills.... As Eric Haughton has been emphasizing for so many years, this may often be due to low frequencies in important component movement cycles."

Carl Binder
Data-Sharing Newsletter, August, 1978
Behavior Pathways Laboratory

Composite Frequencies Constrained by Components

This is true with all kinds of skills

Behavior Components and Composites

- Links and Chains
- Discriminations and skilled movements
- Coordinated movements of multiple components
- Elements of associations or stimulus equivalence
- Terminology
  - Part / Whole
  - Tool Skill / Basic Skill
  - Element / Composite
  - Component / Composite

Removing Ceilings Allowed us to Discover Effects of Rate-building on Mediated Transfer (Stimulus Equivalence)

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Building Endurance to Remove Deficit-Imposed Ceilings

- We found that many of our discrete trials students had little or no endurance or resistance to distraction until they engaged in frequency-building.
- Sprinting has become a standard component of fluency-based instruction.
- Fluency-based endurance has emerged as an antidote for attention deficits (ADD, ADHD, etc.)
- Young behavioral researchers have begun investigating endurance effects.

Understanding Fluent Performance

- Fluency (True Mastery: accuracy + speed)
  - Ergonomics and Practice make the difference!
  - 100% accuracy (traditional “mastery”)
  - Beginner's level (inaccurate and slow)
  - Incompetence (no measurable performance)

Defining Fluency Standards: REAPS – An Empirical Challenge

Retention – Endurance – Application
Performance Standards

We must identify Performance Standards – frequency ranges that optimally support these valuable learning outcomes.

The Origin of REAPS

“When we set performance aims, we’d like to be sure that they are high enough to ensure Retention of skills. Endurance over adequate performance durations, and Application to more complex skills... Several years ago, Eric Haughton turned us on to REAPS, meaning Retention-Application Performance Standards. Since then, we’ve begun to collect information showing the relationship between performance levels and Endurance, thus the revision to REAPS... A good first approximation is to use the performance ranges exhibited by a normally proficient adult population, since we seem to exhibit retention, endurance, and application. Until we gather more information, we’ve been defining REAPS as the normal adult range (usually showing around a 2:1 spread) and using those levels as aims as much as possible.”
Carl Binder
Date: Sharing Newsletter, March, 1981
Behavior Prostheses Laboratory

Estimated Fluency Standards
(Aims/REAPS)

- Tapping a surface: 250-350 per minute
- Writing Digits: 140 to 160 characters per minute
- Arithmetic: 80 to 110 computations per minute
- Keyboarding: 60 to 90 words per minute
- Checking multiple choice items: 15 to 20 per minute
- Brainstorming: 20 to 30+ ideas per minute
- Speaking on a topic: 110 to 170 words per minute (or “at the same pace you’d speak about your hobby.”)
- Dancing at a pace and rhythm that produces pleasure.

Ray Charles on Practice

ROBERT-SIEGEL: You practice a lot?
RAY CHARLES: Wherever I am, I don't – I don't practice as much as I would like to, because I'm not set on a big piano all the time. But I try to, you know, I try to practice a little bit every day for the most part.
ROBERT-SIEGEL: And when you do practice, I mean, do you practice the notes that you'll be playing in the next concert...?
RAY CHARLES: Oh, no, no, no, no, no, no, no, no, no...
ROBERT-SIEGEL: I guess the answer is no, you're saying...
RAY CHARLES: No, No. I practice things like scales and movement of my hands and things like that because, I mean, if I'm going to play on stage, I know, what I'm practicing for is to try to improve what might play, you know. You get relaxed. I mean you just -- you're saying now you got your own mind going... you know, because what you mind thinks – the question is: what your mind thinks, is your fingers going to play it?

ROBERT-SIEGEL: Right.

Interview on National Public Radio
Celebrating Ray Charles 50 years in recording
September 25, 1997

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Stages of Learning for achieving REAPS

- Stage One: Initial Learning
  - Acquiring new behavior
  - Practice components for fluency & endurance

- Stage Two: Application
  - Combining fluent components

- Stage Three: Application
  - Combining fluent components

Each requires different procedures and materials.

Removing Deficit-imposed Ceilings

- We broke through the failures of back-chaining and other accuracy-only procedures with component practice.
- Teachers, OTs, PTs, and LTs developed assessment methods based on component behavior frequencies.
- Instructional designers have learned to focus on component/composite analysis (Haughton, Binder, Johnson & Layng, et al)
- We're pushing the limits of application to actively develop "creativity" and "adduction" - generative instruction.
- Teachers of disabled and autistic students are rediscovering the power of Big Six / Element practice.

4. Handicap-defined Ceilings

"There may be deficits which are irremediable. This is obvious when students are handicapped by severe sensory deficit or permanent physical debilitation. Unfortunately, of course, such impairments are often assumed to be the source of skill deficits, before persistent attempts have been made to remove each of the first three kinds of ceilings... So we may sometimes find, after exhausting every imaginable avenue for remediation, that our students' proficiencies fall far below normal or even functional levels of performance... We must emphasize that the order in which the four ceilings have been described is the order in which attempts must be made to remove them, and that the fourth kind of ceiling represents an admission of failure on our part."

Carl Binder
Data/Change Newsletter, August, 1978
Behavior Prosthetics Laboratory

Removing Handicap-defined Ceilings

- By identifying new behavior components, some have broken through "handicaps" and "disabilities", e.g., auditory discrimination and phonics (Haughton)
- The Terry Harris Story – "Curing" the "incurable"
- Applications beyond special education (regular Ed, corporate training) have encountered few Handicap-defined Ceilings.

Shifting Time Allocation to achieve Fluency
A Corporate Training Case Study

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<th>New Fluency Model</th>
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<tr>
<td>Classroom Lecture</td>
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<td>Reference Aids</td>
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<td>On-the-Job Training</td>
<td>10%</td>
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<td>Observe Tenured Perforers</td>
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<tr>
<td>Fluency Practice Exercises</td>
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<td>55%</td>
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Frequency-building in a Customer Call Center

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How Do We Increase Frequencies?
- Fade from one-at-a-time to continuous opportunities (e.g., from flashcards to worksheets)
- Accentuate amount of work completed and passage of time - and reinforce higher completion rates.
- Use sprints, encourage bursts of behavior.
- Use paced prompting - pointing, nudging, verbal, etc.
- Fast physical guidance - "feel what it's like to be fast"
- "Coaching and Cheerleading" combines paced prompting ("hustles") and non-interrupting reinforcers.
- Get out of the student's way.
- Ask the student what would make her faster.

Practice –Effectively!
- Reasons traditional "drill & practice" fails:
  - lacks explicit fluency criteria as goals
  - long durations stretch endurance and attention
  - often the "chunks" are too big
- Reasons well engineered practice succeeds:
  - includes explicit time-based goals for practice
  - brief durations allow peak performance
  - builds fluent elements before application

Lindsley's Four Operant Freedoms
- Freedom to present stimuli
- Freedom to form responses
- Freedom to repeat responses
- Freedom to speed

O.R. Lindsley
The Behavior Analyst, 1956

While important, they should not be used as an inflexible criterion for effective fluency-based instruction.

What about the Discrete Trials vs. Free Operant debate?
- A better way to frame the discussion is to speak of multiplying response opportunities.
- FIRST free the student from unnecessary fluency blockers. THEN accelerate performance toward fluency in whatever way the data suggest.
- ALWAYS monitor behavior frequencies - even during initial learning or establishing procedures.
- Change procedures, materials, and instructional sequences to find opportunity multipliers.
- Adjust correction procedures, feedback, etc. based on correct and error frequencies and trends.

Ideas and Implications for Researchers
- Avoid artifacts resulting from unexpected measurement ceilings due to design defects.
- Identify REAPS – empirically-determined aims.
- Prevent component deficits from imposing ceilings on designs intended to generate accelerations or jump-ups.
- Control for endurance effects in experiments.
- Assess moment-to-moment distractibility using graphic cumulative response recorders.
- Focus on instructional efficiency as well as effectiveness.
- Do stimulus equivalence research with frequencies!

Binder Riha Associates 02/02/2001

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### Practice Activities for Customer Service - SAMPLE

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<tr>
<th>Learning Channel</th>
<th>Performance Statement</th>
<th>Fluency Standard</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>See/Say</td>
<td>Flash cards with rate plans, product features and benefits</td>
<td>40-60 correct per min, no errors</td>
<td>Content that representatives need “tip of the tongue”</td>
</tr>
<tr>
<td>See/Say</td>
<td>Flash cards with actions or types of information on the fronts, screen codes and buttons on the backs</td>
<td>80-100 correct per minute, no errors</td>
<td>For navigating customer service computer systems (knowing where to go)</td>
</tr>
<tr>
<td>See/Mark</td>
<td>Match rate plans to specific customer requirements</td>
<td>20-30 correct per minute, no errors</td>
<td></td>
</tr>
<tr>
<td>Hear•See/Do•Say</td>
<td>Respond to questions asked by partner by finding and saying info. from online system</td>
<td>6-10 “finds” per minute</td>
<td>Practice navigating system</td>
</tr>
<tr>
<td>See/Do•Write</td>
<td>Complete forms by accessing and writing information from online system</td>
<td>3-6 items per minute</td>
<td>Practice navigating and capturing information from system</td>
</tr>
<tr>
<td>Hear/Say</td>
<td>Respond to difficult questions spoken by partner</td>
<td>Normal confident pace, meeting quality criteria</td>
<td>Combining knowledge with customer service skills</td>
</tr>
<tr>
<td>Hear/Say</td>
<td>Respond to questions covering same content as practice cards, in high paced Jeopardy-like game</td>
<td>Faster than the opponent team</td>
<td>This is another activity for motivating practice on cards, and making it fun</td>
</tr>
<tr>
<td>Free/say</td>
<td>Talk about new marketing program as though speaking with a customer</td>
<td>Normal confident pace, covering all key points</td>
<td></td>
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</table>
## Practice Activities for Sales Knowledge - SAMPLE

<table>
<thead>
<tr>
<th>Learning Channel</th>
<th>Performance Statement</th>
<th>Fluency Standard</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free/Abbreviate</td>
<td>Reasons for achieving fluency in sales knowledge</td>
<td>15-25 ideas per min.</td>
<td>Introductory exercise</td>
</tr>
<tr>
<td>See/Mak</td>
<td>Sort statements of potential customer needs into categories of the Customer Needs Model</td>
<td>20-30 per min. correct, no errors</td>
<td>Establishes needs categories for later use in probing, etc.</td>
</tr>
<tr>
<td>See/Say</td>
<td>Practice flashcards with “factoid” level of information about markets, customer needs, products, competition, etc.</td>
<td>40-60 cards per min, 0-1 errors</td>
<td>Several sets chunked by section in Sales Guide</td>
</tr>
<tr>
<td>Free/Say or Free/Abbreviate</td>
<td>Details recalled from card sets “blurted out” or rapidly abbreviated on paper</td>
<td>25-35 correct details per minute</td>
<td>Known as “Rapid Recall” exercise, used to ensure retention of card content</td>
</tr>
<tr>
<td>Hear/Say</td>
<td>Ask probing sales questions, given a type of need stated by a practice partner</td>
<td>6-8 questions per minute</td>
<td>Can prompt with “frames” for types of questions</td>
</tr>
<tr>
<td>Hear/Say</td>
<td>Fronts and backs from flashcards, in group</td>
<td>20-30 per minute</td>
<td>Group drill, useful for some types of meetings/groups</td>
</tr>
<tr>
<td>See/Mak</td>
<td>Match product feature to customer needs</td>
<td>15-20 per minute</td>
<td></td>
</tr>
<tr>
<td>Free/Say</td>
<td>Talk about a product and the types of needs it addresses</td>
<td>normal confident pace for 1 minute</td>
<td></td>
</tr>
<tr>
<td>See/Say</td>
<td>Talk through slides from a full customer presentation</td>
<td>normal confident pace</td>
<td>Practice for delivering presentations</td>
</tr>
<tr>
<td>Free/Say</td>
<td>Deliver “elevator speech” about why customer should buy from our Company</td>
<td>normal confident pace, all key points</td>
<td></td>
</tr>
<tr>
<td>Hear/Say or See/Say</td>
<td>Respond to tough questions and objections from practice cards, or from partner reading</td>
<td>normal confident pace, all key points</td>
<td></td>
</tr>
</tbody>
</table>
## Pinpointing Worksheet

**Performance objectives/area:** Improving ASI scores at ATTWS

<table>
<thead>
<tr>
<th>Learning Channel</th>
<th>Performance Statement</th>
<th>Fluency Standard</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>See/Mark</td>
<td>Select best way to say a given thing from a choice of 4 options.</td>
<td>count/min aims (correct and errors)</td>
<td>These all teach the rep to DISCRIMINATE positive from less positive ways to communicate with customers.</td>
</tr>
<tr>
<td>See/Abbreviate</td>
<td>Find positive or negative examples of different types of language in written transcript and use abbreviation of category to indicate (e.g., emp + or emp -, own + or own -).</td>
<td>count/min aims (correct and errors)</td>
<td></td>
</tr>
<tr>
<td>Hear/See/Mark</td>
<td>Listen to taped interactions and follow along on transcript to mark positive and negative examples in different ASI categories (e.g., tone of voice, etc.)</td>
<td>count/min depends on pace of tape</td>
<td></td>
</tr>
<tr>
<td>See/Say or Hear/Say</td>
<td>Improve response to a customer statement by re-stating it with better wording, etc. Can be done alone (S/S) or with a partner (H/S), or in a group (H/S). Use cards with response on front and suggestions or guidelines on back for defining quality criteria.</td>
<td>confident pace, making key points or improvements</td>
<td>This teaches the rep to IMPROVE statements and responses to the customer.</td>
</tr>
<tr>
<td>See/Say or Hear/Say</td>
<td>Respond to a customer statement with appropriate quality of language and voice. Can be done alone (S/S) or with a partner (H/S), or in a group (H/S). Use cards with bullet points and guidelines on back for defining quality criteria (Q&amp;A model)</td>
<td>confident pace, making key points or improvements</td>
<td>This teaches the rep to RESPOND appropriately</td>
</tr>
<tr>
<td>See/Say or Hear/Say</td>
<td>Restate/clarify customer concern, using vague or complicated statements of concerns printed on front of cards with guidelines or models for how to clarify/restate on back. Can be done alone (S/S) or with a partner (H/S), or in a group (H/S).</td>
<td>confident pace, making key points or improvements</td>
<td>These teach key SKILL elements that are part of ASI</td>
</tr>
<tr>
<td>See/Say or Hear/Say</td>
<td>Ask questions to clarify customer concern, using incomplete or ambiguous statements of concerns or facts printed on fronts of cards with guidelines or models for questions to ask on back. Can be done alone (S/S) or with a partner (H/S), or in a group (H/S).</td>
<td>confident pace, making key points or improvements</td>
<td></td>
</tr>
<tr>
<td>Hear/Say</td>
<td>Say appropriate small talk, depending on what customer says. Work with partner reading a sentence or two to provide opportunities to raise appropriate topics, etc.</td>
<td>Confident pace, judged by partner to be appropriate</td>
<td>You might want to list some specific criteria for what's ok and what's not.</td>
</tr>
</tbody>
</table>
# Pinpointing Worksheet – AWS AXYS Navigational Exercises

<table>
<thead>
<tr>
<th>Learning Channel</th>
<th>Performance Statement</th>
<th>Fluency Standard</th>
<th>Design Notes</th>
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</thead>
<tbody>
<tr>
<td><strong>SEE/CLICK</strong></td>
<td>Go to a screen by using a button that appears to the user</td>
<td>as fast as the system will allow -- gather data on repeated practice by trainers or top performers to estimate aims</td>
<td>Create a series of “Go to…” steps that also include a periodic “Close All”, and simply require the user to click on buttons with words corresponding to the “Go to” statement. Use big type in steps to make reading easy during practice. Try both See/Click in which user works solo and Hear/Click in pairs or in group practice.</td>
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<td><strong>HEAR/CLICK</strong></td>
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<td>- whole group</td>
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<tr>
<td><strong>SEE/CLICK</strong></td>
<td>Go to a screen using a button that the user cannot see on the screen from which s/he begins, but is one click away.</td>
<td>same</td>
<td>Use “Go to…” statements that specify screens/buttons that are <em>not</em> visible from where the user begins each step. Once users are super fluent on the first exercise, this one will introduce the need to know where some buttons are located on screens users cannot initially see. That is, it will go beyond simply locating the target button on a screen to knowing where that button leads (i.e., to another screen/button). Same types of exercise variations</td>
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<td><strong>SEE/CLICK</strong></td>
<td>Go to types of information <em>stated in plain English</em> by clicking on buttons to navigate one or more clicks away.</td>
<td>same</td>
<td>Similar to above except the user is now using the system/buttons to find information that they might need to access on the job. Introduce this after users achieve super fluency on above, and as you introduce purposes and applications of screens in training sequence. Prior activities are prerequisites for this one.</td>
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