Conducting Fluency Research: Topics, Tools, and Designs

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& Friends

Agenda

- Introductions and Stage-setting
- REAPS and other Research Topics - Carl Binder
- Topics and Specific Designs - Kent Johnson
- Aims, Screening, Placement, etc. - Clay Starlin
- Advanced Charting/Analysis Tools - Ogden Lindsley
- Break-out Design Sessions - All
- Debrief and Wrap-up
Workshop Objectives

- Identify fluency research topics & questions
- Specify independent variables & measures
- Design procedures
- Select appropriate measures and designs
- Use the Standard Chart for analysis

Rationale for Workshop

- Most of what we know is from thousands of single-learner clinical replications.
- Rigor of knowledge so far is in the tool - the Standard Celeration Chart
- We have not met like this before.
- We want to “seed” the field with research ideas and designs for more formal work.
- To encourage more research and sharing among those able to conduct it.
- To leave with specific, concrete designs.
Some Assumptions / First Principles

- Frequency is a *dimension* of behavior.
- Proficiency in all areas of human behavior involves both time/pace and accuracy/quality.
- To validate specific fluency standards requires one or more external referents (as in medicine).
- The domain of behavior frequencies is a fabric of ratios, ranges, and components/composites.
- Single-subject design is fundamental.
- The standard celeration chart is a basic tool.

Skinner’s Most Important Contributions

“I have had a lot of luck in my scientific career. As I look back on it, it seems to me that two important things were the use of rate of responding as a basic datum and the so-called cumulative record which makes changes in rate conspicuous.... A cumulative record makes visible at a glance changes in rate of responding over long periods of time. It permits an instantaneous analysis of behavior as an experiment proceeds.”

Historical Context

- The operant chamber: beyond alley ways and jumping stands - convenience plus uninterrupted streams of behavior
- The cumulative recorder
- Ferster, 1953
- Lindsley and Skinner with humans
- Lindsley: Standard Celeration Chart, Precision Teaching
- Haughton, Starlin, Kunzelmann, et al: aims, REAPS
- The rest of us: fluency research and development
  - Barrett, Binder, et al - Behavior Prosthesis Lab
  - Graf, Eshlemann, McDade, and many others
  - Johnson, Layng, et al - Morningside Model
- Corroborating results from other fields

Rate of Response

- Probability of behavior
- Behavior frequencies
- Procedures have frequencies
- Frequency matching: behavior/environment
- Measurement sensitivity
- Frequency is a dimension of behavior
Levels of Performance

- Fluency (True Mastery: accuracy + speed)
- 100% accuracy (traditional "mastery")
- Beginner's level (inaccurate and slow)
- Incompetence (no measurable performance)

What We Know

- **RETENTION**: Higher frequencies seem to predict better Retention and Maintenance of behavior.

- **ENDURANCE**: More rapid uninterrupted "automatic" responding seems more resistant to distraction and fatigue, more stable.

- **APPLICATION**: Increasing the frequency of component behaviors seems to improve transfer/application in new and more complex behaviors.

We need to know a lot more!
REAPS: An Empirical Challenge

Retention – Endurance – Application
Performance Standards

We must identify Performance Standards that optimally support these critical learning outcomes.

Four Kinds of Ceilings at the Behavior Prosthesis Lab

- Measurement-defined: 100% correct ceiling
- Teacher-imposed: materials and procedures
- Deficit-imposed: component behaviors
- Handicap-defined: irremediable deficits
Component / Composite Behaviors

- Elements and compounds
- Tools movements and basic skills
- Discriminations and skilled movements
- Stimulus equivalences / mediated transfer
- Links and chains
- Components and composites

Classifying Operants by Channel Sets

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Examples

- SEE/SAY cards (SAFMEDS)
- SEE/SAY practice sheets
- SEE/WRITE practice sheets
- SEE/MARK practice sheets
- HEAR/SAY questions/responses
- HEAR•SEE/SAY fluency aids
- HEAR/DO follow directions
- FREE/SAY talk about a topic

Fluency Research: Dependent Variables

- Frequencies of composite behaviors
- Celerations of composite behaviors
- Frequency dividers or multipliers
- Accuracy ratios (correct / error frequencies)
- Celeration multipliers
- Variability of behavior (bounce as a ratio)
- Suppression ratios (distractibility)
- Others?
Constraints: Ratios, Ceilings, and Celerations

- Component/composite ratios may impose ceilings if component frequencies are low.
- Ceilings may cap celerations, truncate phases, mask effects.
- Observing some effects may require x5 to x10 spread or change in independent variables, e.g., practice durations and beginning frequencies for endurance effects.
- Check to be sure procedures mirror real-life human frequencies and ranges.

Beyond Practice Sheets

- Much of what we know is based on a narrow range of behavior – academic performance on PT practice sheets (S/MARK, S/WRITE S/SAY, H/SAY, etc.)
- There are many other domains of behavior, e.g.:
  - athletics, performing arts
  - fine and gross motor skills (OT, PT)
  - professional verbal behavior
  - professional manual skills
  - social behaviors and “soft” skills

Issue: The Fidelity of Laboratory Analogs
Trials Latencies vs. Free Operant Frequencies

- How similar to behavior in natural settings?
- Are the ranges of latencies comparable to ranges of naturally occurring frequencies?
- How disruptive are frequent interruptions?
- Fluency outcomes probably combine effects of latencies and response durations.
- The danger of studying statistically significant but clinically insignificant phenomena.
- Free operant operant analogs may be preferable.
- The challenge of removing ceilings.

Retention and Maintenance Defined

- Retention: The ability to perform a behavior at a given level after varying periods of no opportunities to do so ("remembering").
- Maintenance: The ability to perform a behavior at a given level after varying periods of opportunities to do so.

In a well-sequenced curriculum, maintenance may often be more relevant than remembering in the pure sense.
Retention: Background

- Verbal learning studies and "overlearning"
- Early PT results - maintenance checks
- Orgel and Bower, 1984
- Berquam, 1991
- Recent theses and dissertations
- Is it amount of practice or is it fluency per se?

Retention: Designs

- Practice to different frequencies and check correct frequencies and accuracy ratios at various intervals later
- Option: control for amount of practice
  - arguments for and against
- Differences between types of behaviors (e.g., paired associates vs. motor tasks)
- Maintenance opportunities vs. no opportunities

Note: retention aims may differ from what is required for endurance, application, etc.
Endurance Defined

Endurance: The ability to maintain a given level of performance over extended performance intervals with stability and resistance to distraction.

Issue: Resistance to fatigue, stability, and resistance to distraction may be separate effects.

Endurance Background

- Marylin Cohen first used the term “endurance” in the 1970’s to refer to the ability to maintain a performance frequency over longer timings.
- Eric Haughton promulgated the term in the 1980’s with REAPS, and with sports analogies, “sprints,” etc.
- Van Houten confounded performance duration with covert/overt timing procedures.
- Binder systematically changed timing durations and looked for effects.
- Binder’s dissertation sorted out Van Houten confounding and reported a free operant analog of LaBerge and Samuels (1972) latency procedures for assessing distractibility.
Endurance Measures

- Changes in correct and error frequencies over extended periods or with changes in performance durations, as a function of beginning correct frequency.
- Changes in bounce envelope over extended durations or with changes in duration, as a function of beginning correct frequency.
- Suppression ratio (rate during distracting stimulus / rate without distraction) as a function of beginning correct frequency and performance duration.

Endurance Designs

1. Change practice durations and look for effects on correct frequencies and accuracy.
2. Change practice durations and look for effects on celerations.
3. Parametric study of range of beginning correct frequencies x range of practice durations (both ranges x5 to x10).
4. Impose distracting stimulus during free operant performance with different beginning frequencies and use cumulative recorder and suppression ratio to assess effects.
Application Defined

**Application:** The ability to acquire and/or accelerate performance of more complex behaviors (programmed or "novel") as a function of component behavior performance frequencies.

Application Background

- Old learning lab studies of whole/part learning and transfer.
- Haughton, Starlin, et al built component behaviors to specific levels ("aims") and checked for frequencies and acceleration of composites.
- Van Houten established math composite as a "baseline" and introduced phases of frequency-building with component behaviors (e.g., writing digits).
- Binder conducted pilot studies of "rate-building in a mediated transfer paradigm."
- Haughton, Binder, Pollard, Solsten, et al found that new self-care and vocational behaviors emerged with frequency-building of component behaviors.
- Johnson and Layng explicitly built curriculum to take advantage of "generativity."
Application Measures

- Correlation between component and composite behavior frequencies.
- Frequency and accuracy of composite behaviors as a function of component behavior frequencies.
- Emergence of composite behaviors, accuracy, or change in composite behavior frequencies as a function of component behavior frequencies.

Application Designs

1. Build component to a given frequency, then check on frequency and acceleration of composite (A-B-A-C, etc.) in sequence.
2. Probe composite behavior periodically as "baseline" and alternate phases of component frequency-building with none.
3. Establish stimulus equivalence and then assess effects on emergence and/or frequency of new behaviors after phases of frequency-building on components.
4. Measure ratio of component/composite in competent performers, then attempt to build frequency of component or composite behaviors for new learners, assessing relationship between ratio and celeration/ceiling.
Break-out Sessions

Output: For each of several designs....

- Select a research topic / question(s)
- Identify setting(s) and subjects
- Pinpoint behaviors and measures
- Define phases / interventions / procedures
- Identify constraints, parameters, etc.