Implications of Selectionism for Applied Measurement of Behavior

International Precision Teaching Conference

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Some elements from paper in symposium “Exploring Selectionism for Behavior Analysis”(C.Merbitz, Chair) Presented at the 28th annual Convention, Association for Behavior Analysis, Toronto, CA,

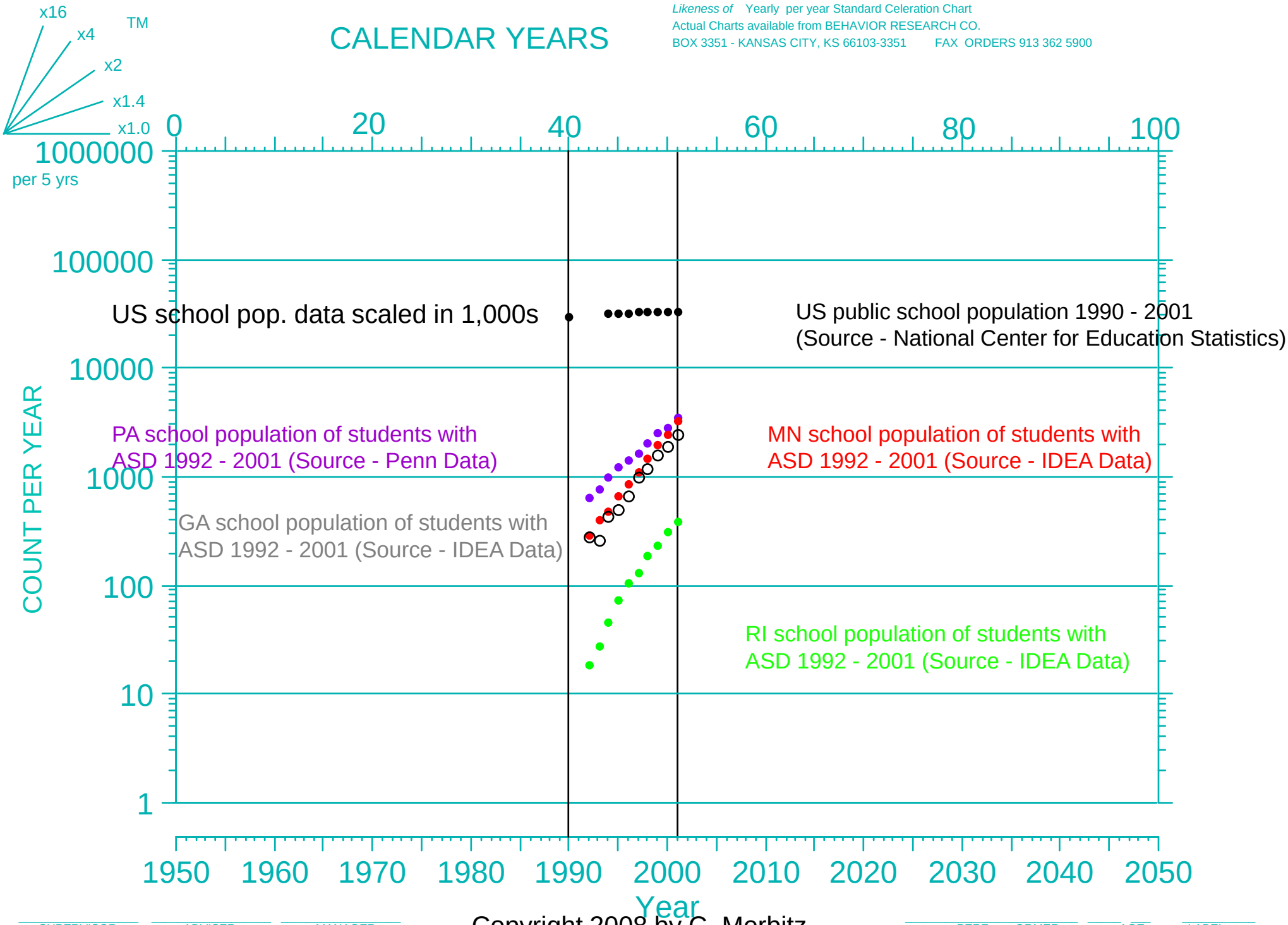
May 25, 2002

Overview

- “Applied” Behavior Analysis
- Selectionism
  - Essentials of the model
  - Biology
  - Behavior
- Some elements of PT as a metric useful in applied settings
- Examples
- Scientific task for Applied Behavior Analysis &PT

“Applied” Behavior Analysis

- Some providers hold the BCBA
- Some do not; simply self-described “I do ABA”
- USA = + $$ contingencies for marketing
  - Response cost for all of that other stuff - why add to the expense by collecting, plotting, updating etc all that data?
- ABA procedures moderately effective even without data
  - Clients self-select into successful” & “other”
  - VR reinforcement for clinical applications of sloppy ABA
- The Market for ABA (next)
- Anecdotal assertion - the pyramid of “appliers” (after next)



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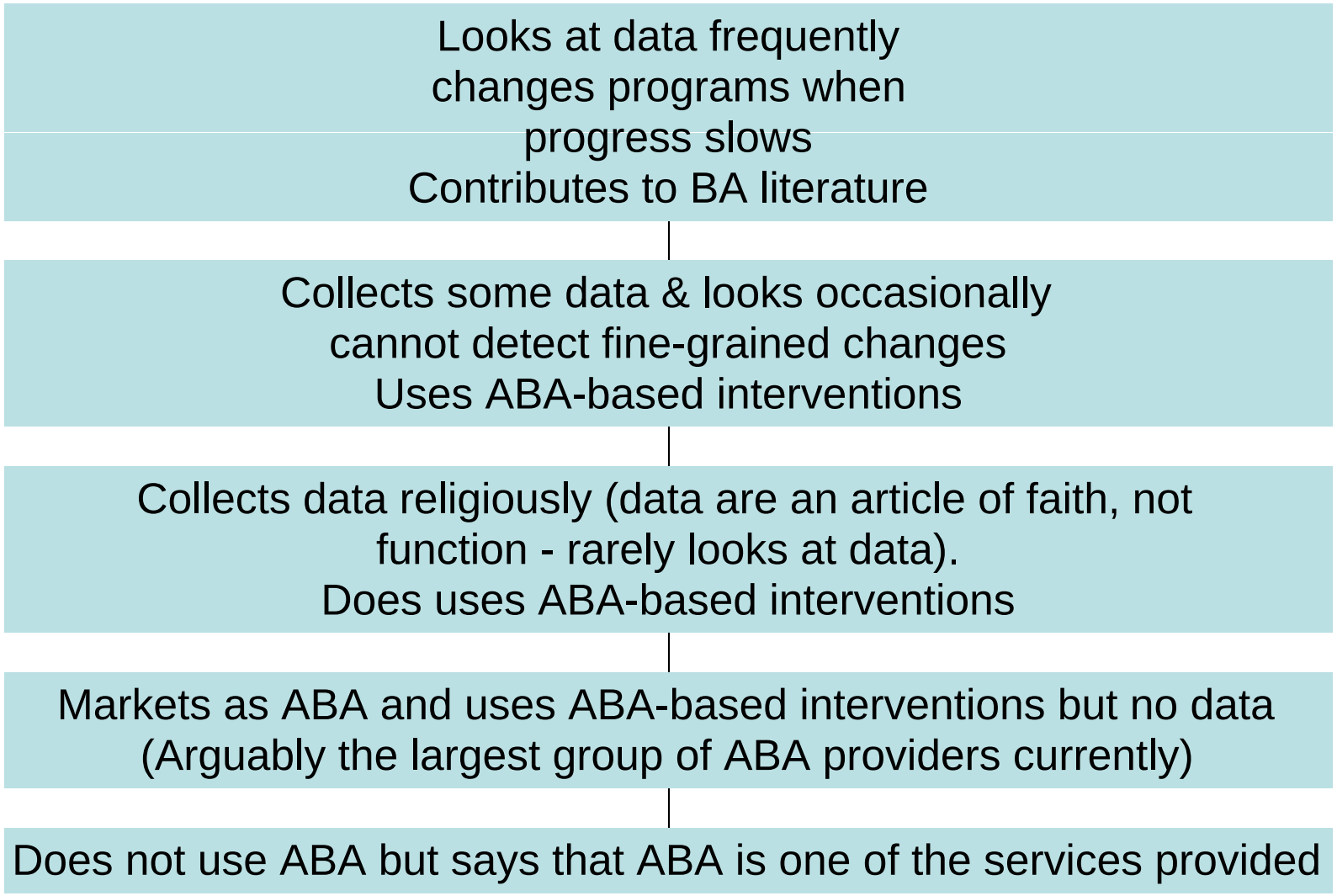
YEARLY per year CHART | ORGANIZATION | TIMER | COUNTER | R. Kubina CHARTER | COUNTED

A Pyramid of ABA Providers



What's important?

- Effective **procedures** (ABA; not the focus today)
- A **data-driven** application
  - Immediate change in behavior or slower acquisition over time
  - Accurate prediction and early detection of change
  - Easy, sensitive, fast, accurate data analysis (later)
- **Model** of how it works --
  - BFS: Selectionism for behavior (next topic) & its implications for measurement

Essentials of **selectionism**

- Given a population (e.g., birds) with differential survival / propagation
- Three properties that make selection inevitable (JM Smith,1984):
  - Multiplication (new entities occur)
  - Heredity (like the old ones)
  - Variation (but not exactly)
- These play out
  - In real time
  - In some environment(s)

Selectionism as a model (2)

- “Selection” - a relation between environment and a class of entities that occurs over time.
- Entities:
  - may be a bird, behavior, plant, etc.
  - has “features” by which we identify it
  - has inheritance of the features
- Tells a story about the relationship
- Time is the substrate of selectionism (& life) - thus we should have a time-series if we have good data.

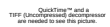
Selectionism - measuring its effects over time

- Time passes & entities vary.
- We may measure entities by counting:
  - how many of each type (e.g, with a given feature)
  - occupy a given area (space)
  - at a known time-slice: (Count-type-area)/time
- If selection occurs, the number of these entities will change. We express the speed of change as (Count-type-area)/ time/time.

Example: finches on an island

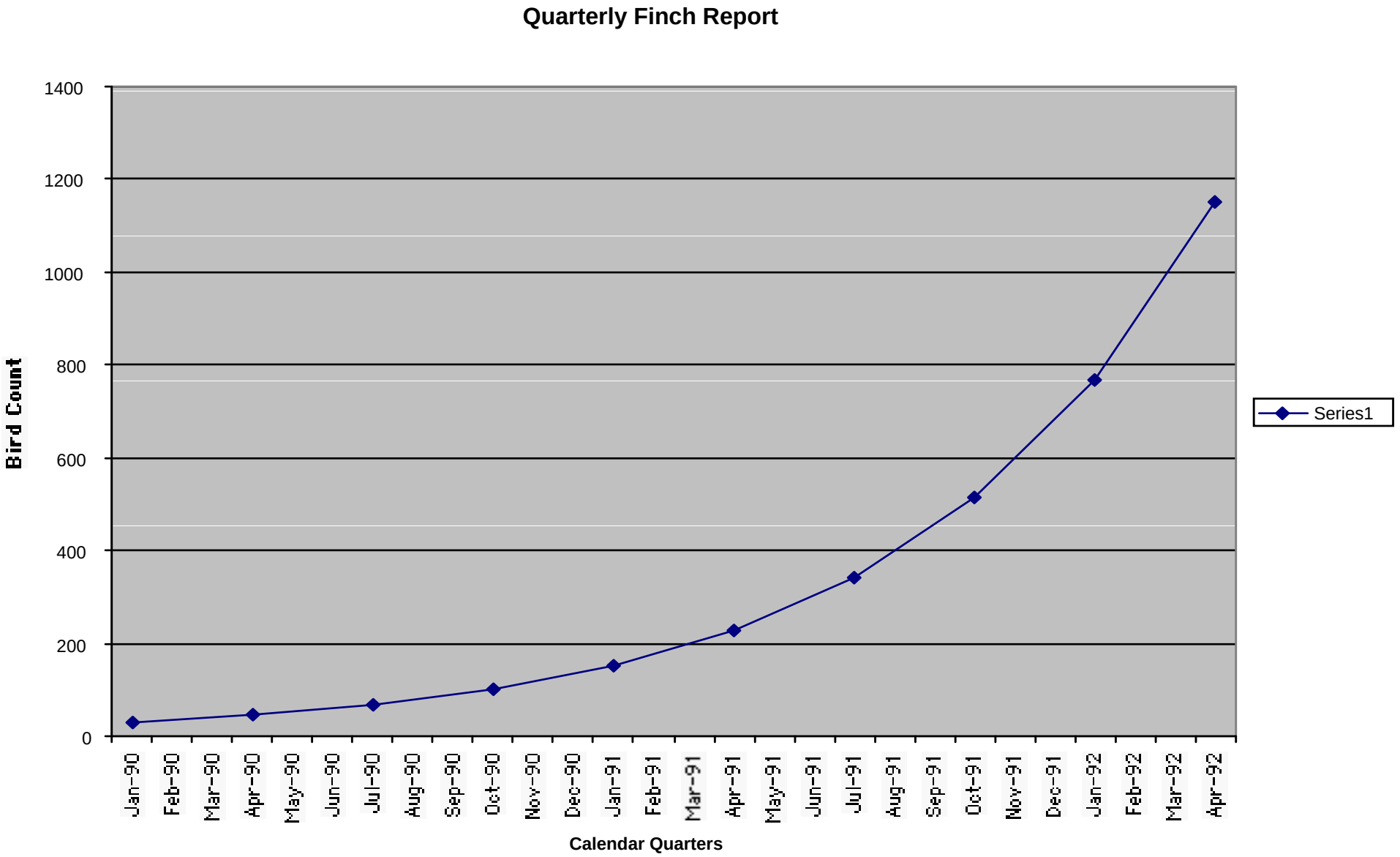
- Finches colonize a habitat & reproduce
- Food, predators, etc. impact the finches
- What do we see when selection occurs?
- Count the finches! (Please be accurate…)
- Over time, the counts of finches reflect the population change...expressed as birds per acre/day/year (note standard units here).

Lady Gouldian Finch

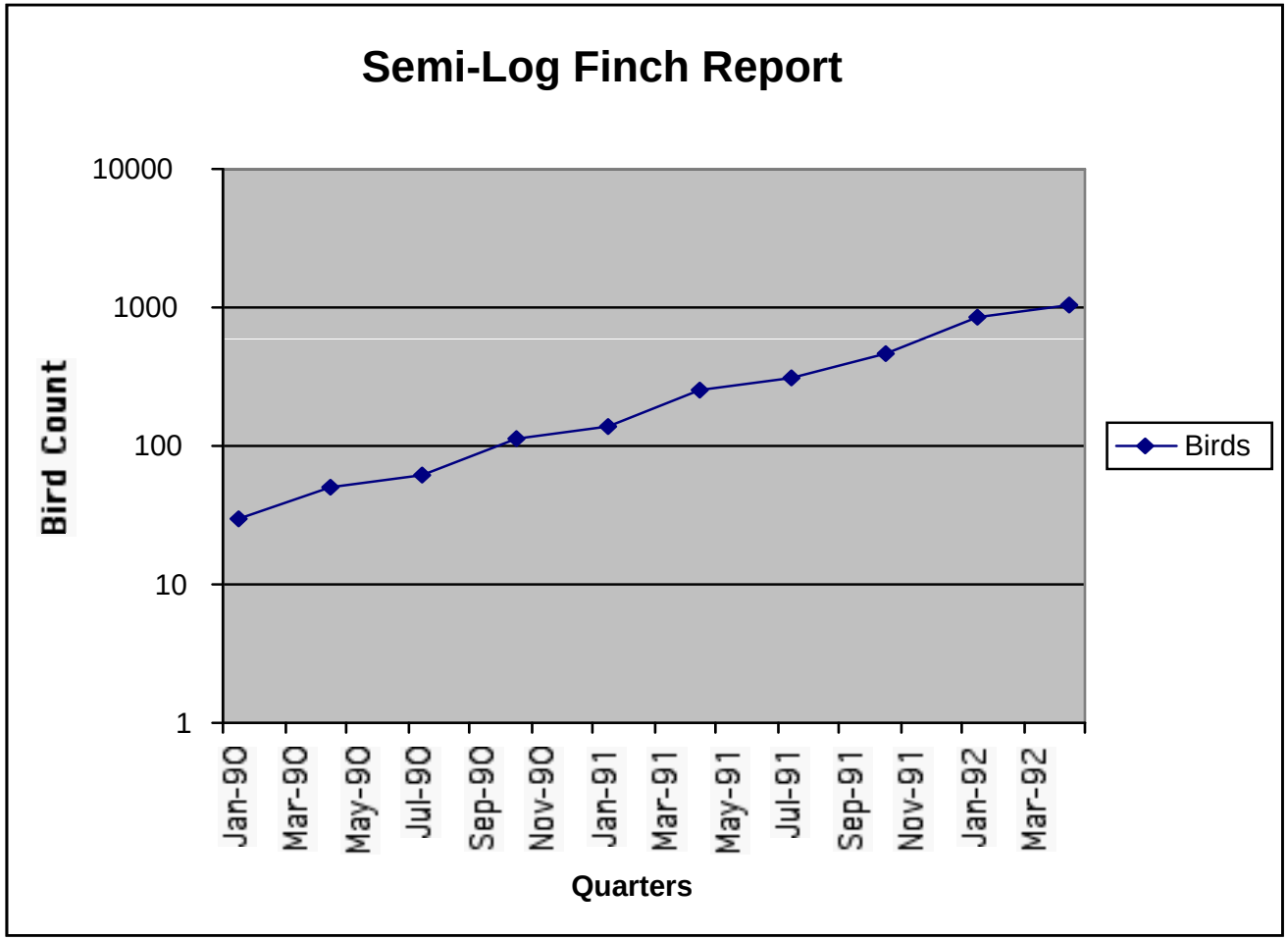


finches on an island…2

- Gouldian finches/acre
  - 30 on January 1
  - 26 Feb 1
  - 20 Mar 1
  - 45 April 1
- If this population multiplies by 1.5 every quarter…the X1.5 number equally describes both
  - The population change in that environment &
  - Selection effects of that environment



Another picture of these data



Quarterly Finch Report: Meanings

- Measure of the hospitality of the ecological niche on that island for the finch
- Logically, it is equally accurate as a measure of the suitability of the finch for the island and the island for the finch
- A measure of the selection of the finch by the environment of the island
- A measure of the intersection of the island and finch population over time

Behavior (thanks BFS & J&P)

- …is that part of an organism's interaction with its environment characterized by detectable displacement in space over time…
- … is defined by its effects in the environment
- …occurs in an ABC relation
  - Antecedent, behavior, consequence
- …occurs in space & time…so is countable in principle

The “ABC” unit (1)

- Our basic operant - FR1
  - “B” is emitted in the presence of
    - Antecedent(s) and followed by
    - Consequence
- A is the first part of the spatial/temporal environment within which the “B” may be emitted
  - If emitted, C occurs, forming ABC
  - If not, A only occurs
  - An A like this might reoccur or might not

The “ABC” unit (2)

- Free operant - from BFS
- Response instance - one B in an environment (A) that meets our criteria as a class member
- Response class = population of AB’s
- Easy, revealing dependent measure is rate
  - Count/unit time
  - Count of AB’s that meet criteria for class membership with or without the C occurring for each B

A…C

- Convention: let A...C denote an environment in which the B will be reinforced if it occurs.
- Of course, the organism only experiences the C when the appropriate B is emitted.
- ABC = response under stimulus control
- A…C = opportunity to respond

Behavior over time

- If a series of A…C opportunities are presented, we will get higher and higher proportions of ABC units if the response is selected.

- We call a C a reinforcer when more ABCs per unit time are seen.

Selectionism - in behavior measuring its effects over time

- Time passes & behaviors vary.
- We may measure behaviors by counting:
  - how many of each type
  - within a given area (A..C relation)
  - at known time-slices: (Count-type-area)/time
- If selection occurs, the count of behaviors will change. We may express the speed of change as count/time/time.

Count/time/time

- Speed of selection = speed of change = count/time/time
- Because time occurs in standard units, ANY selection process can be measured in terms of count/time/time…
  - Reading at correct wds/min/week
  - Affectionate comments at comments/day/month
- Thanks to Ogden Lindsley!

Aside - for ABA in the noisy world:

- Did not say “count per time per session”
  - Plot of “sessions” transforms an interval axis to ordinal
  - Assumes that stimulus control is stronger than anything else in the person’s life (e.g, police, sickness, etc)
  - Adds to the difficulty of multiple baseline comparisons across behaviors or people
  - Conceals variability due to unplanned events
- “Sessions” is fine when it works because our control is good but time (e.g., days) is always accurate because we live in time & need fewer assumptions
- Example

Example: Days

- Many records include dates & sometimes they are revealing, such as Case W.
- Student was manager of day program for people with DD. Typical project:
  - Staff complaint of tantrums
  - Requested program to “reduce behaviors”
- The daily pattern
- The reality

Ok, so what good is count/time/time?

- Usually people don't give a repeated burst of a single behavior unless in training situations
  - Way to tell if training is done
  - Builds components of more complex behaviors - estimate of the propensity of that behavior to be recruited into a more complex performance
- Provides a nice estimate of the propensity of that behavior to be emitted when A occurs
- An easy measure of the speed of selection

Building complex behavior

- All visible behavior(s) are composites that can be analyzed into simpler components.
- Useful components are recruited into larger composites
- Frequency of these isolated components is an easy way to predict if they will become incorporated into a composite behavior
- Example follows

Kent's Component skills for factoring 4x^2-10xy+4y^2

Skill	Frequencies needed
Write numbers 0-9	160-180 /min correct
+-*/ math facts	80-100 written fact answers/min correct
+-*/ variables to the first & second powers	130-150 letters & numbers/min correct
+-*/ negative numbers	130-150 digits/min correct

Selection example: SAFMEDS

- "Say All Fast A Minute Each Day Shuffled"
  - Small card: Question side & answer side.
  - Look at Question, say Answer
  - Time for 1 min., do as many as you can
- ABC model:
  - Repeated A's- stimulus sides of SAFMEDS
  - B = correct response, I = error
  - C - Check back for effect (correct / incorrect answer.)
  - grade contingency
- Populations: correct (AB) and incorrect (AI)
- *Thanks again Ogden!*

SAFMEDS data

- Vertical lines are days, heavy lines are Sundays
- Blue dots are frequencies of correct responses per minute
- Red X’s are frequencies of incorrect responses per minute
- Intention is to select correct and deselect incorrect
- Build a population over time such that any A evokes a B (correct response).

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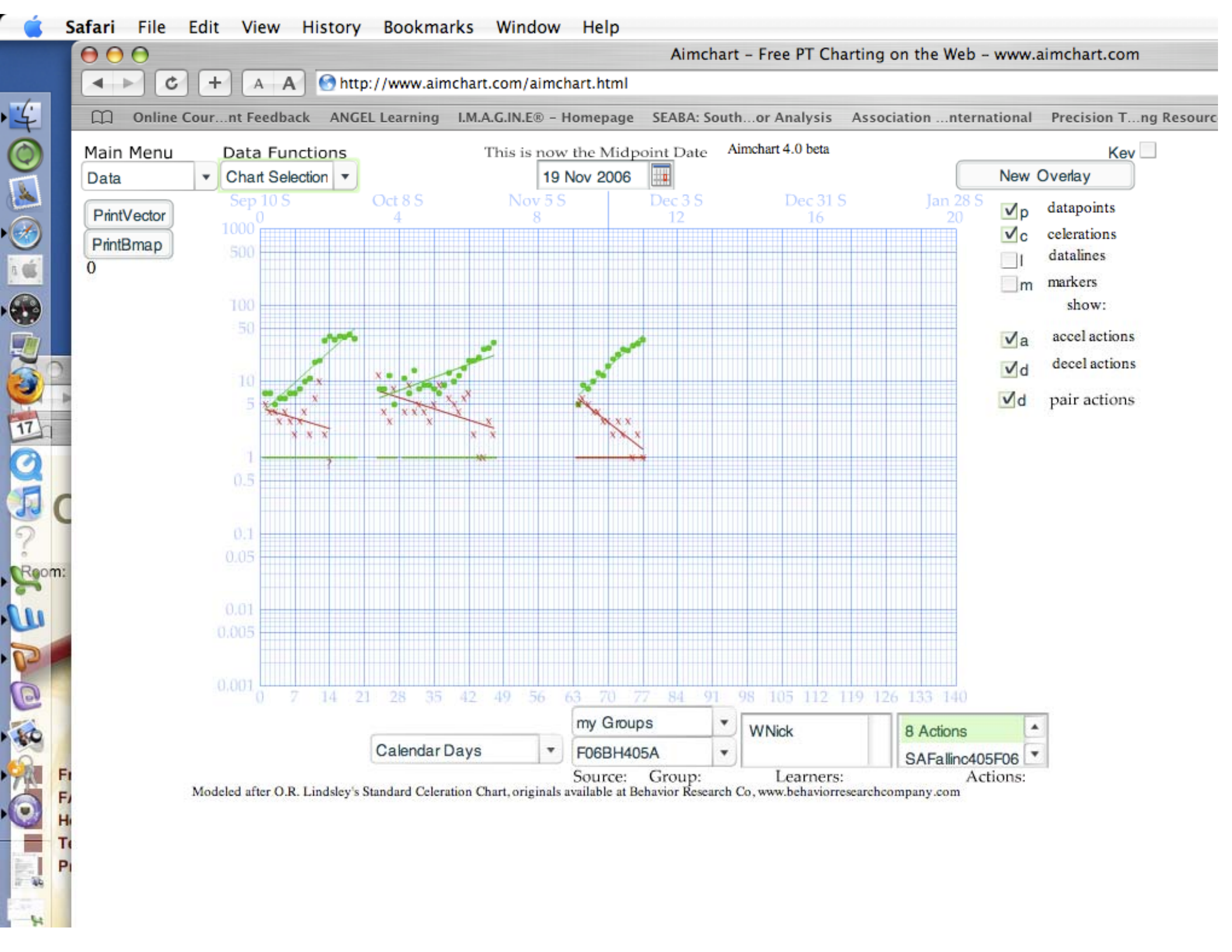
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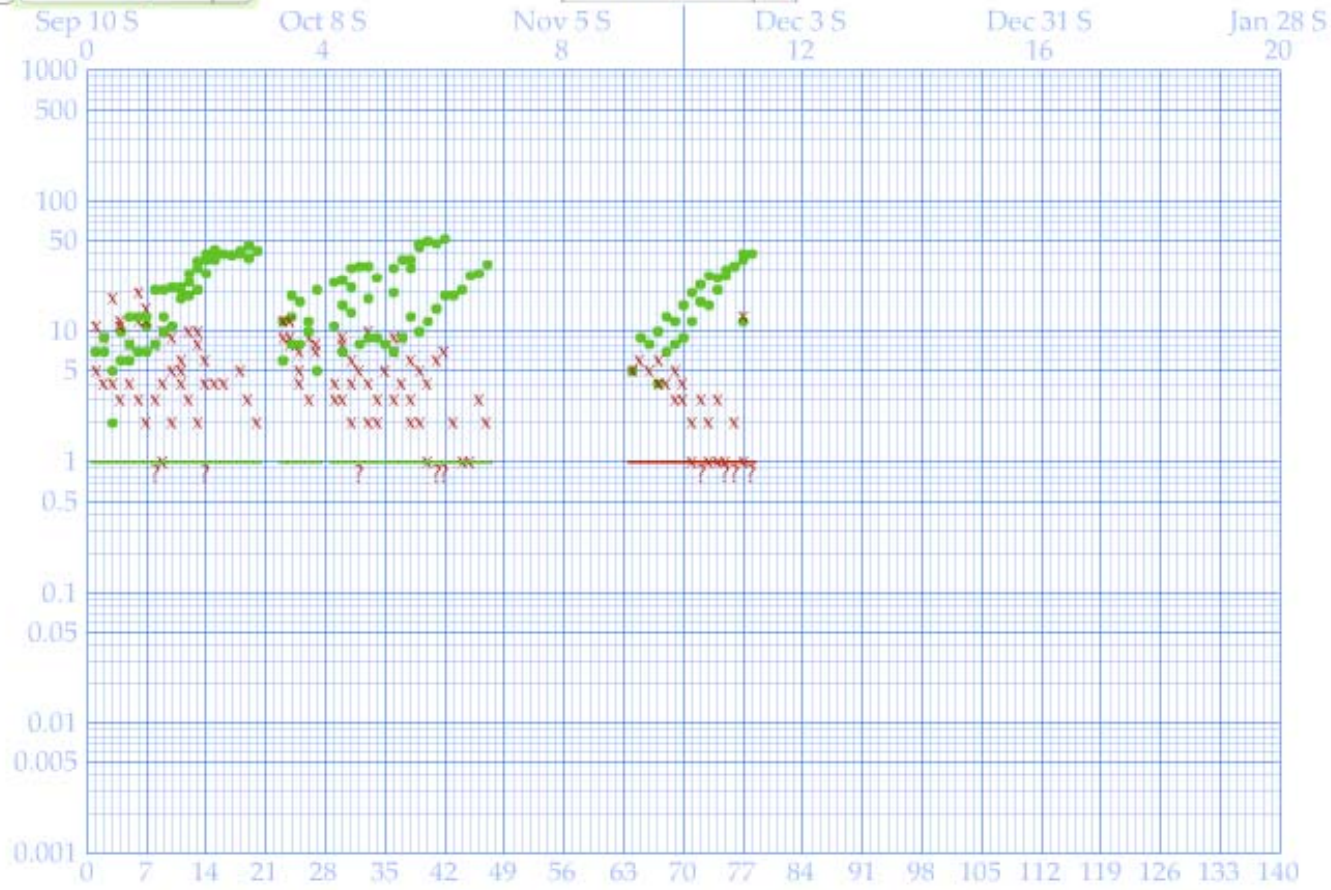

Calendar Days

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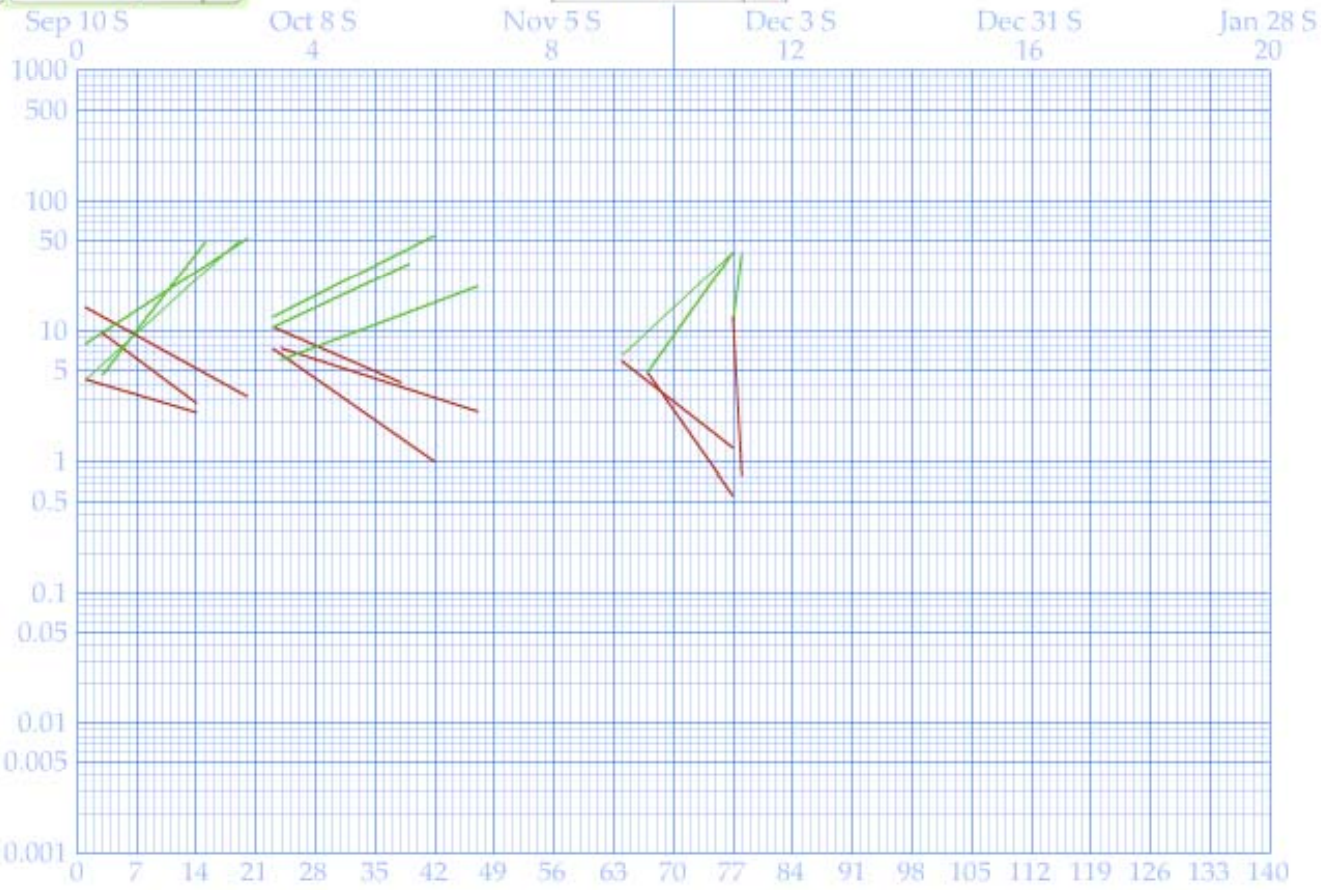

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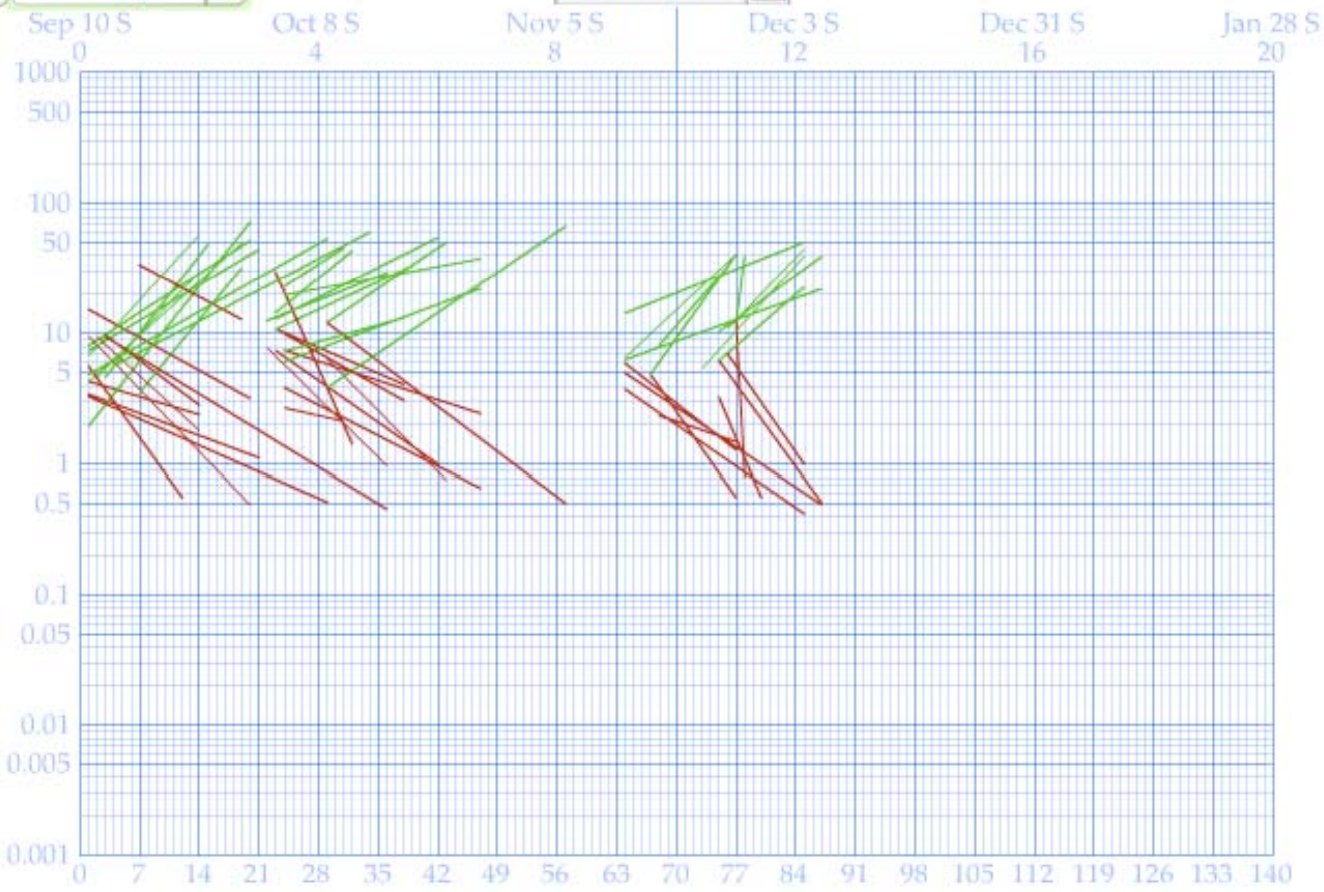

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Parallels

- Biology
- Ecosystems
- Time
- Count/time
- Count/time/time
- Selection

- Behavior
- A…C occurrences
- Time
- Count/time
- Count/time/time
- Learning

If you could measure speed of selection, what could you do?

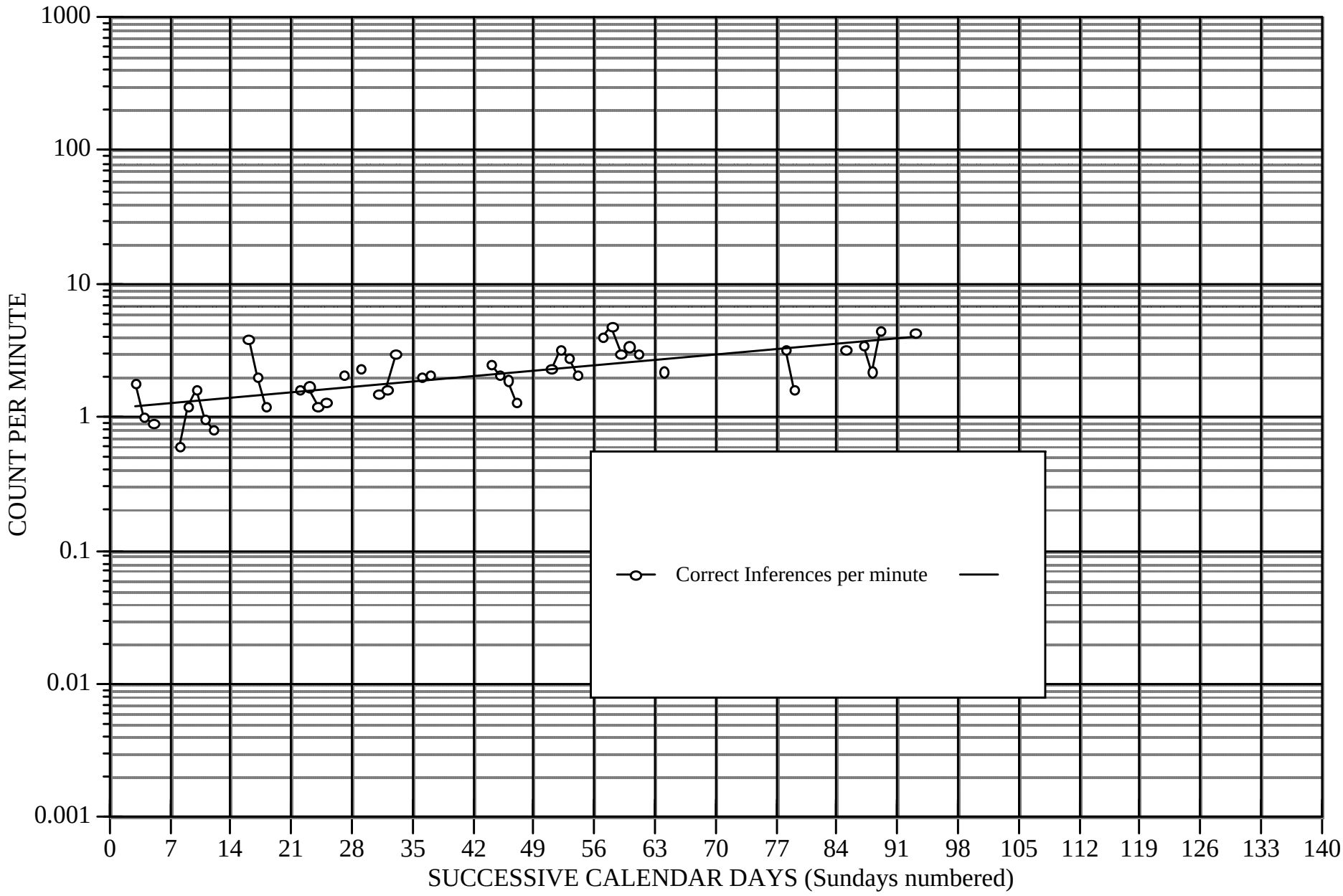
- Experimental Analysis & scientific control:
- *Predict the occurrence of the feature at a future point in time*
- *Change environment and see if the prediction was broken*
- *Learn what to do to make the feature appear and disappear in the future*
- *Arrange environments for faster selection…*

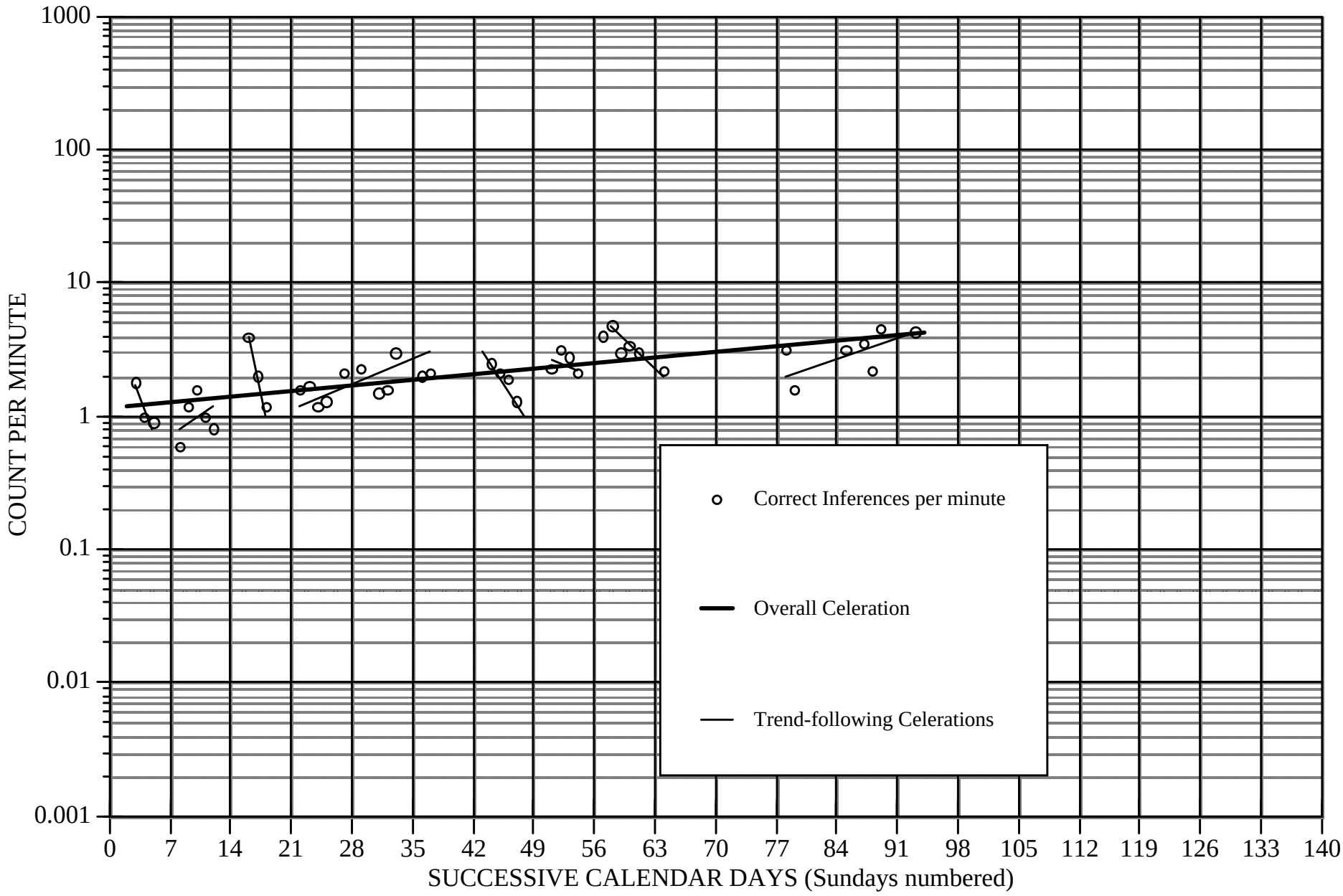
Application 2: Case Example

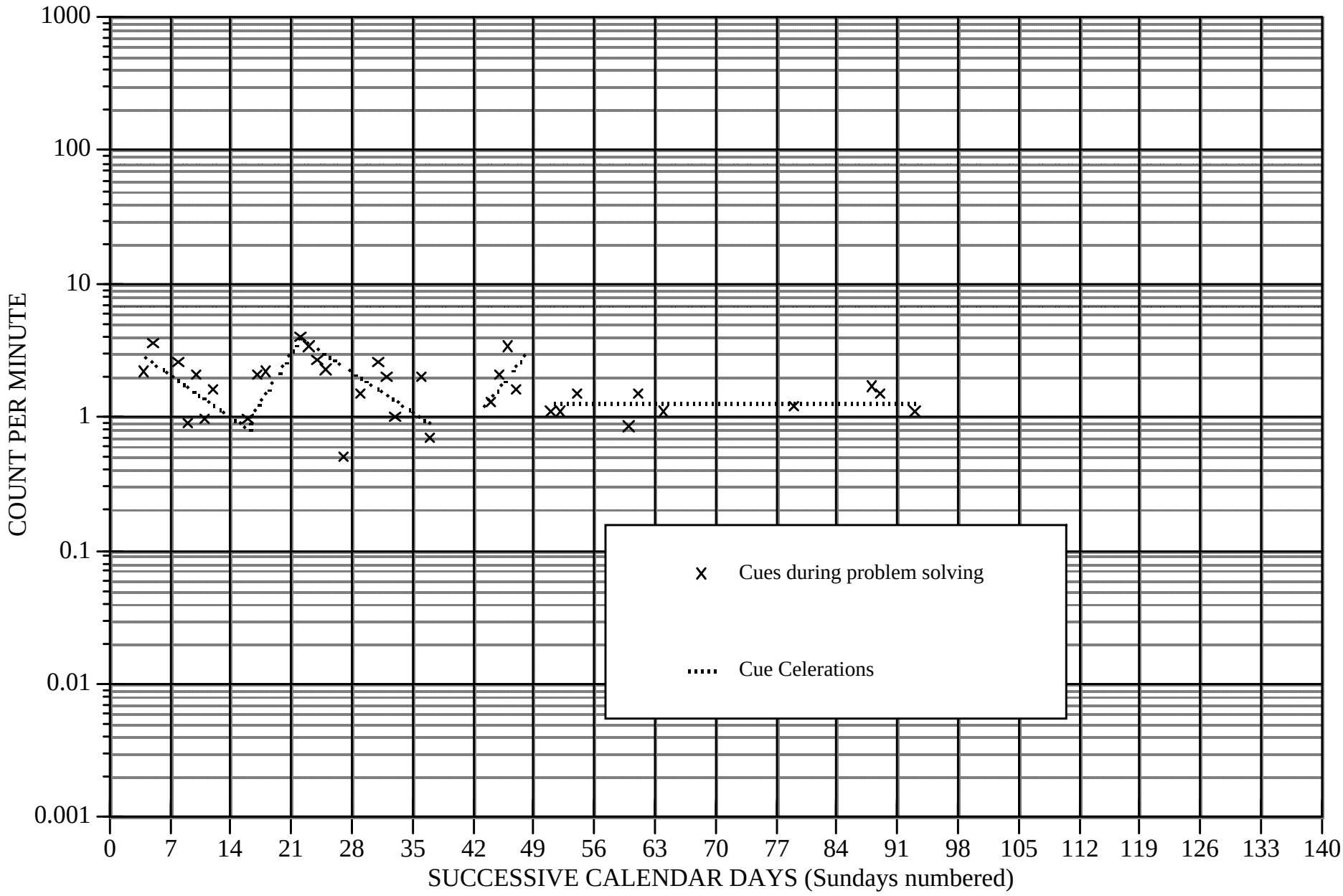
- Traumatic Brain Injury Rehab case- MVC
- Young adult male
- Multiple injuries, fx, brain trauma
- Confused, agitated, memory impaired, aggressive, impulsive…
- Inpatient goals included:
  - improve logic/memory

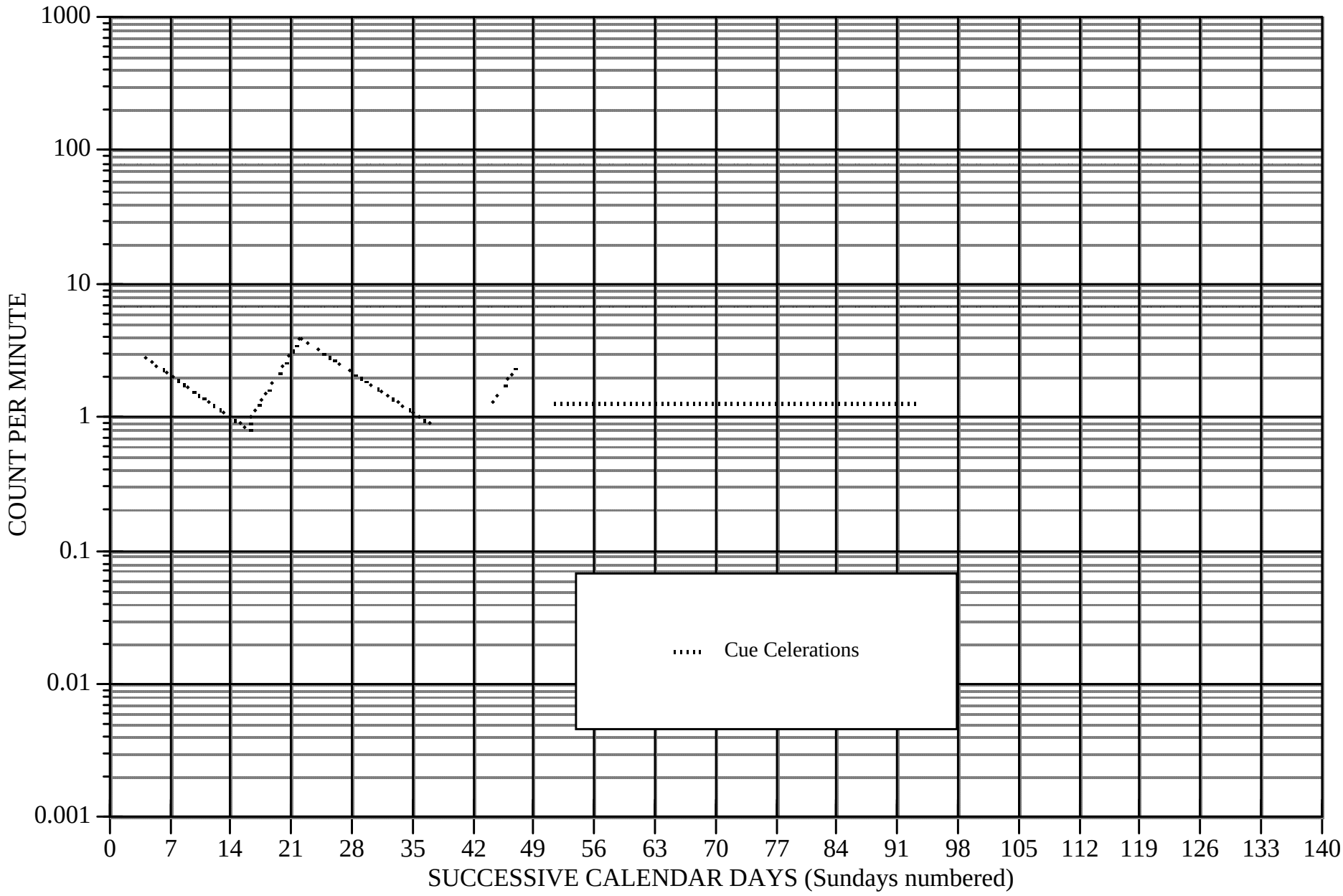
Speech-Language task “Mindbenders”

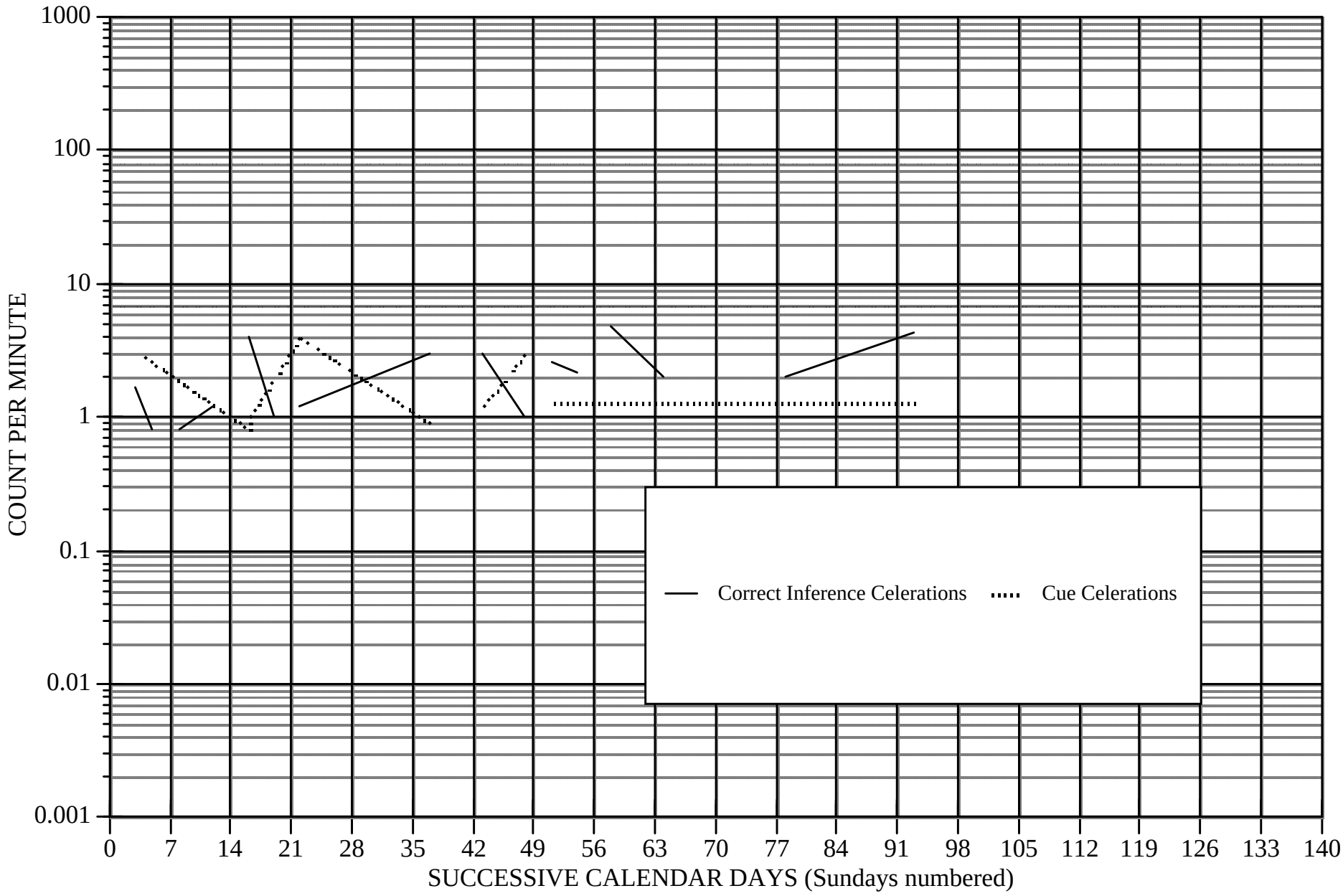
- Mindbenders like this given 2/ day:
  - a horse, a dog, and a cat
  - Names are Pluto, Chigger, and Bucky
  - The dog’s name does not begin with a “P”
  - The cat’s name is shorter than the dog’s
  - Who is the dog?
- Counted corrects, errors, cues by the SLP
- Charts show corrects & cues/min.

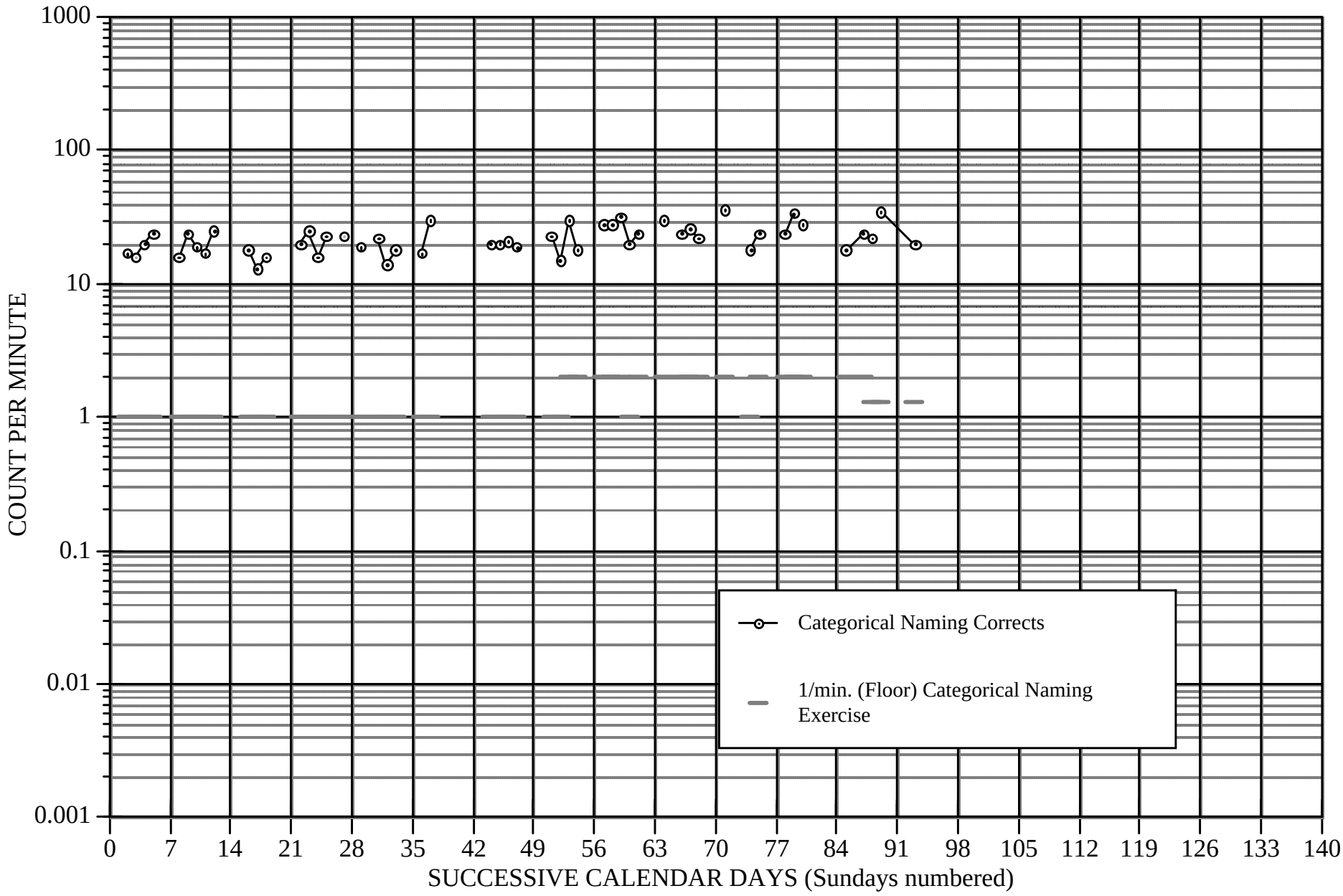












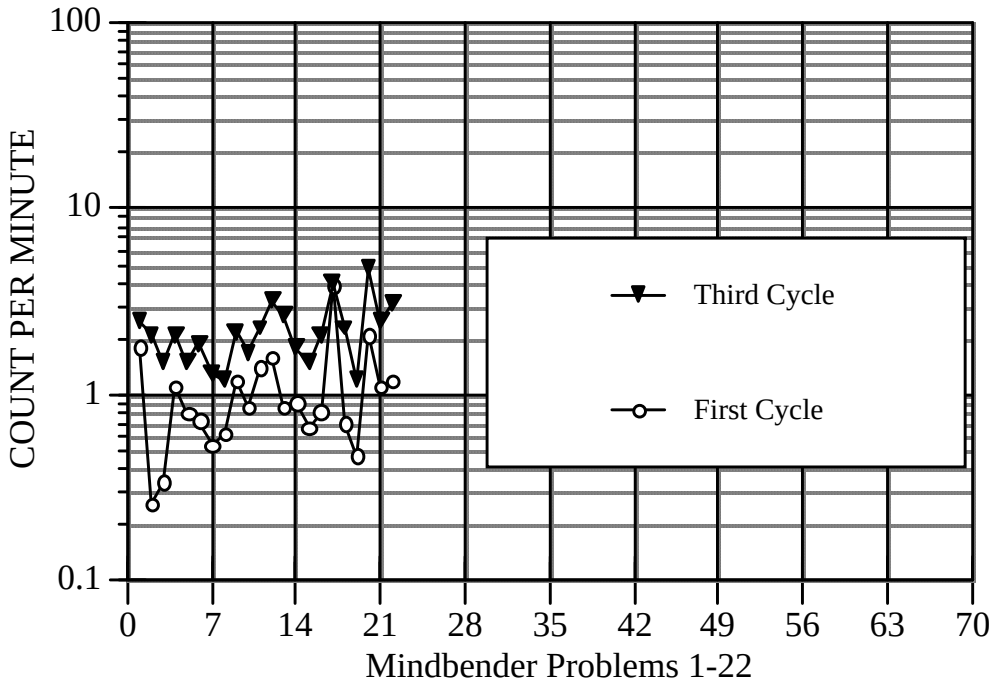


Figure 2. Frequencies of correct inferences on the first and third cycles through Mindbender problems 1-22.

To help effectively, we need to base ongoing change decisions on data. **We need:**

- A reasonably accurate model of the process
- Precise and timely measures of key outcome elements
- Power to make changes & observe outcomes
- Process control made explicit
- *The single-subject design applied to life.*

Any life changing process occurs in time

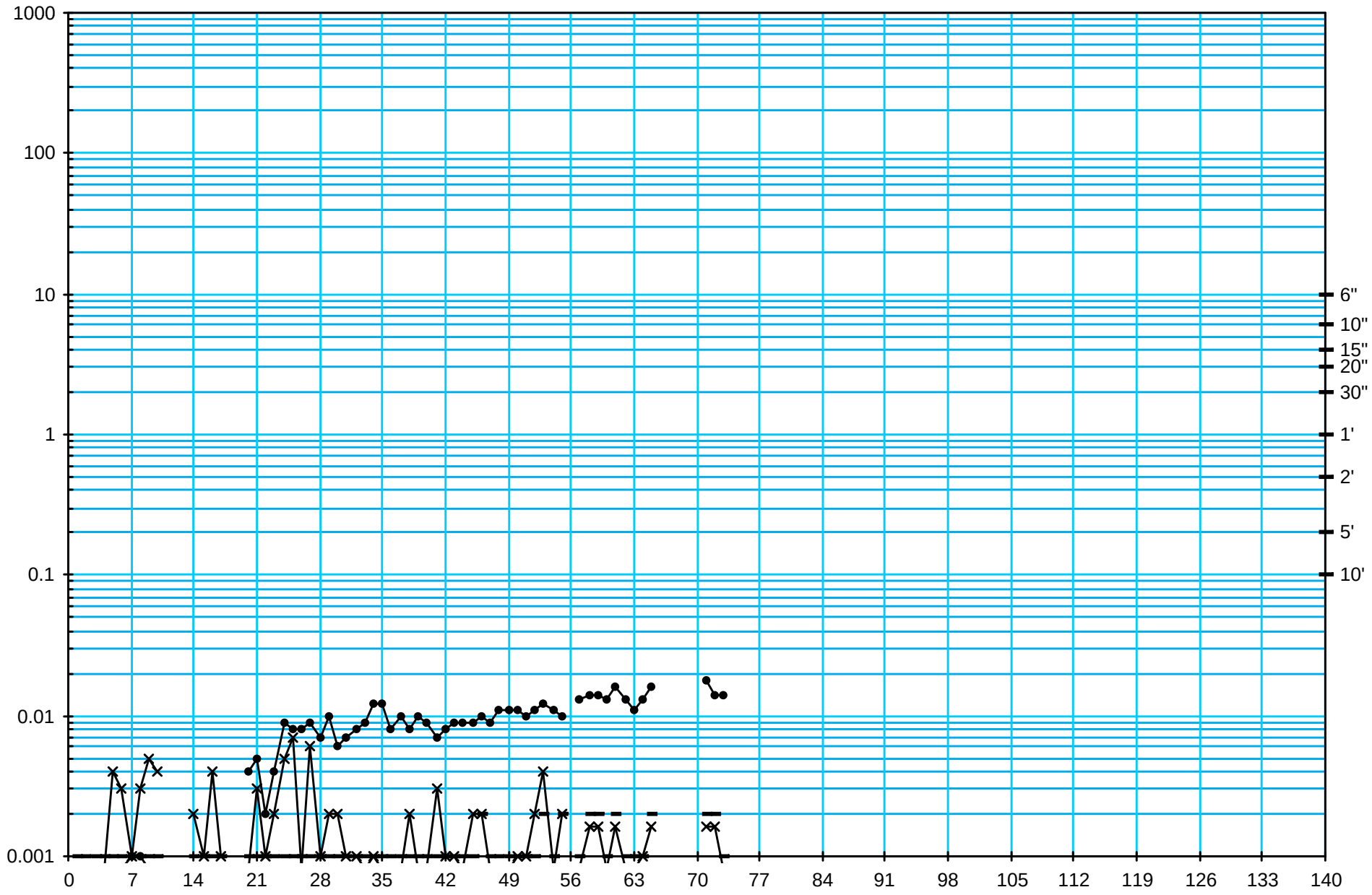
- Therefore, the process must be intelligible both
  - as a story and
  - as a time series: sets of counts & dates, jumps, celerations of related events
- A stream of events within a probabilistic but firmly causal net…
- We attempt to relate certain sets of events to other sets by the story and by the time series
- To “relate events” we need good data, organized to support the detection of the relationships in time
  - Some characteristics of good data follow

Desirable Characteristics of Goals . . . Measures . . . Data

Simple	Concrete	Visible	Discrete
Shared, public	Self-correcting	Countable (ratio-level)	Relevant (valid)
Sensitive	Achievable	Predictive	Consistent
Important	Interpretable	Robust	Reliable
Comparable	Cheap	In-the-stream	Replicable
Resistant to misinference	High signal-to-noise ratio	No ceiling, no floor	Time-conserving

Application 3: Case Example

- Nursing home resident, older demented male
- Staff reported “behaviors” to be eliminated.
- <Note ethical issue here>
- Order was entered to count his positive behaviors as well as “negative” ones…
- Meeting with staff to define countable categories
- …so this is staff’s detection of his actions



Behaver: HW

Successive Calendar Days (by weeks)

Target: Nurses record behavio

Our scientific / technological task

- Predict what a given person will do at a specific time & environment
- Any person's life should make sense:
  - As a story
  - As a time-series
  - Thus behavioral problems should be modeled as a time series, too.
- If it does not make sense with our current data, what else / how else should we measure?

Thanks!

- Selectionism from B. F. Skinner & others (e.g., Baum)
- Factoring example from Dr. Kent Johnson, Morningside Academy, 1996
- SAFMEDS Data Slides from Aimchart.com
- Data characteristics: van der Ploeg, A. & Merbitz, C. (1998, November) *Data-Driven Decision Making in Classrooms: Vision, Issues, and Implementation.* Paper presented at the annual conference of the American Evaluation Association, Chicago, IL.
- Case 3 from presentation by Nancy Merbitz, Ph.D
- Merbitz, C.T., Miller, T. K., Hansen, N. K., (2003). Cueing and Logical Problem Solving In Brain Trauma Rehabilitation: Frequency Patterns In Clinician And Patient Behaviors. European Journal of Behavior Analysis, **4,** Nos.1 & 2. (Originally published in *Behavioral Interventions* (2000), **15***;*169-187, selected by editors of EJOBA for reprinting).