Definition of Measurement

• The process of applying quantitative labels to observed properties of events using a standard set of rules
Researchers Need Measurement

• How scientists operationalize empiricism
  – Without measurement, science is guesswork and opinion

• Applied behavior analysts measure behavior to answer questions
  – Basis for talking about behavior
Practitioners Need Measurement

• To evaluate effects of intervention
  – Before and after treatment
  – During treatment
• To guide decision making
• To prevent mistakes
  – Continue ineffective treatment
  – Discontinue effective treatment
Benefits of Measurement

• Optimize effectiveness
• Verify legitimacy of treatments
• Identify and end use of pseudoscience
• Accountability
• Meet ethical standards
Measurable Dimensions of Behavior

- Dimensions are distinct features that can be measured
- Three fundamental properties
  - Repeatability or countability: behavior can be counted
  - Temporal extent: duration
  - Temporal locus: when behavior occurs
Measures Based on Repeatability

- **Count**
  - Number of responses emitted during an observation period
- **Reported as frequency count**
- **Measures of count alone do not provide sufficient information for analysis**
Measures Based on Repeatability

- Rate/Frequency
  - Ratio of count per observation period
- More meaningful than count alone
- Include counting time for reference
- Rate of correct and incorrect responses helpful in skill development
- Reported as number per standard unit of time
Guidelines for Using Rate

• Take complexity of response into account
• Useful measure for free operants
• Not appropriate for responses within discrete trials
• Not appropriate for continuous behavior over extended period
Measures Based on Repeatability

• Celeration
  – Measure of the change in rate of responding per unit of time

• Reported using Standard Celeration Chart

• Captures behavior acceleration and deceleration
Measures Based on Temporal Extent

• Duration
  – The amount of time a behavior occurs

• Total duration of session

• Duration of each occurrence

• Reported in standard time units

• Count and duration measures provide different pictures of same behavior
Measures Based on Temporal Locus

• Response latency
  – Measure of elapsed time between onset of stimulus and initiation of response

• Typically reported as mean, median, and range
Measures Based on Temporal Locus

• Interresponse time
  – Amount of time that elapses between two consecutive instances of a response class
• Direct measure of temporal locus and related to rate
• Reported as mean, median, and range
Derivative Measures

• Percentage
  – A ratio formed by combining the same dimensional qualities
  – Expresses proportional quantity

• Proportion of correct to incorrect

• Proportion of observation intervals when behavior occurred
Considerations for Using Percentage

- Often misunderstood, used incorrectly
- Most accurate with divisor of 100 or more
- Percentage may be misleading
- Limited use because has no dimensional quantity
- Sets artificial limits on behavior change
Derivative Measures

- Trials-to-criterion
  - Measure of the number of response opportunities needed to achieve a predetermined level of performance
- Other measures can be used to determine trials-to-criterion (e.g., rate)
- Typically calculated *post facto*
- Used to compare effectiveness
Definitional Measures

- Topography
  - The physical form or shape of a behavior
- Measurable dimension
- Malleable by consequences
- Not a fundamental quality of behavior
Definitional Measures

• Magnitude
  – The force or intensity with which a response is emitted

• Important parameter for some response classes
  – E.g., voice volume

• Not a fundamental quality of behavior
Procedures for Measuring Behavior

- Typically involve one or a combination of these three:
  1. Event recording
  2. Timing
  3. Time sampling methods
Event Recording

• Procedures for detecting and recording the number of times a behavior is observed

• Devices include:
  – Wrist counters, digital counters, masking tape, paper clips, etc
Considerations for Event Recording

- Easy to do
- Behavior must have discrete beginning and ending
- Rate must not be too high
- Inappropriate for behaviors with long duration
Timing

• Procedures to measure duration, response latency, and interresponse time

• Duration:
  – computer systems, stopwatch, wall clocks, tape recorder

• Response latency and interresponse time
  – Precise recording of duration between events of interest
Time Sampling

• Variety of methods for observing and recording behavior during intervals or at specific moments in time

• Observation is divided into intervals, presence or absence of behavior recorded for each interval
Time Sampling: Whole-Interval Recording

• Used to measure continuous behavior
• Brief intervals (5-15 seconds)
• At end of interval, record if behavior occurred throughout
• Risk of underestimation
• Reported as percentage of intervals when behavior occurred
Time Sampling: Partial-Interval Recording

- At end of interval record if behavior occurred at any time during interval
- Multiple occurrences scored as one
  - Does not capture duration
- Allows recording of multiple behaviors
- Reported as percentage of intervals when behavior occurred
Time Sampling: Momentary Time Sampling

- Record whether the behavior is occurring at the end of the interval
- Does not require undivided attention
- Misses much behavior
  - Best for continuous behavior
- Reported as percentage of intervals when behavior occurred
Time Sampling: Planned Activity Check

• Variation of momentary time sampling
  – Measures behavior of individuals within a group

• At end of interval, measure number of students engaged in target activity
Guidelines for Time Sampling

• Use a timing device to signal beginning and end of observation
  – Increase accuracy
  – Not distracted by watching a stopwatch

• Record a response for every interval (e.g., yes or no)
  – Prevents losing your place with blank intervals
Time Sampling Artifactual Variability

- Artifact is something that appears to exist because of the way it is examined or measured
- Time sampling provides estimate of actual occurrences
- Different procedures produce different results
- Differences produce variability in data
Measuring Behavior by Permanent Product

- Measuring behavior after it has occurred by measuring its effects on the environment
- *Ex post facto*
- All previous procedures can be applied to permanent product measurement
- Products can be a natural or contrived
Advantages of Permanent Product Recording

• Practitioner free to do other tasks
• Possible measurement of otherwise inaccessible behavior
• More accurate, complete, continuous
• Easier data collection (IOA, treatment integrity)
• Measurement of complex behavior
Determining Appropriate Use

• Is real-time measurement needed?
  – Moment to moment decisions required

• Can behavior be measured by permanent product?
  – Each occurrence must produce same product
  – Product can only be produced by target behavior
Determining Appropriate Use

- Will a contrived product affect the behavior?
  - Reactivity effects
- Cost to obtain and measure the permanent product?
  - Availability, cost and effort of generating the product
Computer-Assisted Measurement

• Data collection and analysis software combined
  – Multiple systems available
  – Sophisticated and easy to use
  – Laptops, hand-held computers, PDAs

• Simultaneous recording of multiple behaviors across multiple dimensions