Reversal and Alternating Treatment Designs

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Reversal and Withdrawal Designs

- To discuss single-subject designs and how they manage the issues of internal and external validity, we need to review our experimental logic.

Single-subject designs

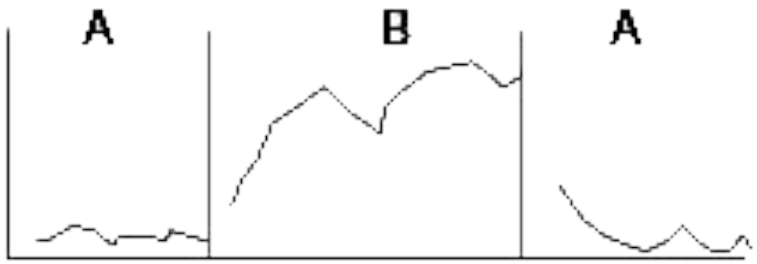
- Single-subject research involves:
  - **Identifying** an individual or individuals whose **behavior you'd like to improve,**
  - **Defining precisely** the behavior in measurable terms,
  - **Assessing stability** in behavior before a treatment is applied, **(baseline)** and
  - **Replicating** the change from baseline conditions to treatment conditions.
  - **Repeatedly Verifying** that changes in behavior vary with changes from baseline to treatment

Experimental Designs

- Given the power of experimental logic, single subject researchers, clinicians, teachers and others have designed many systematic ways of examining prediction, verification, and replication.
- The first of these is called the withdrawal or reversal design.

Withdrawal/Reversal Designs

- These designs have at least three conditions:
  - Baseline
  - Treatment
  - Return to Baseline



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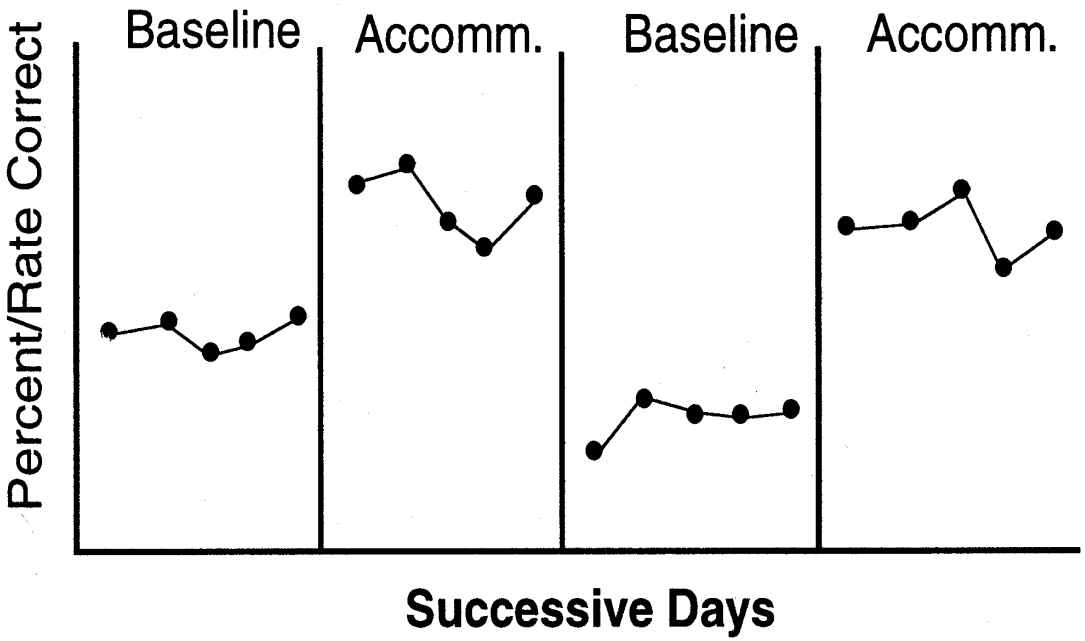
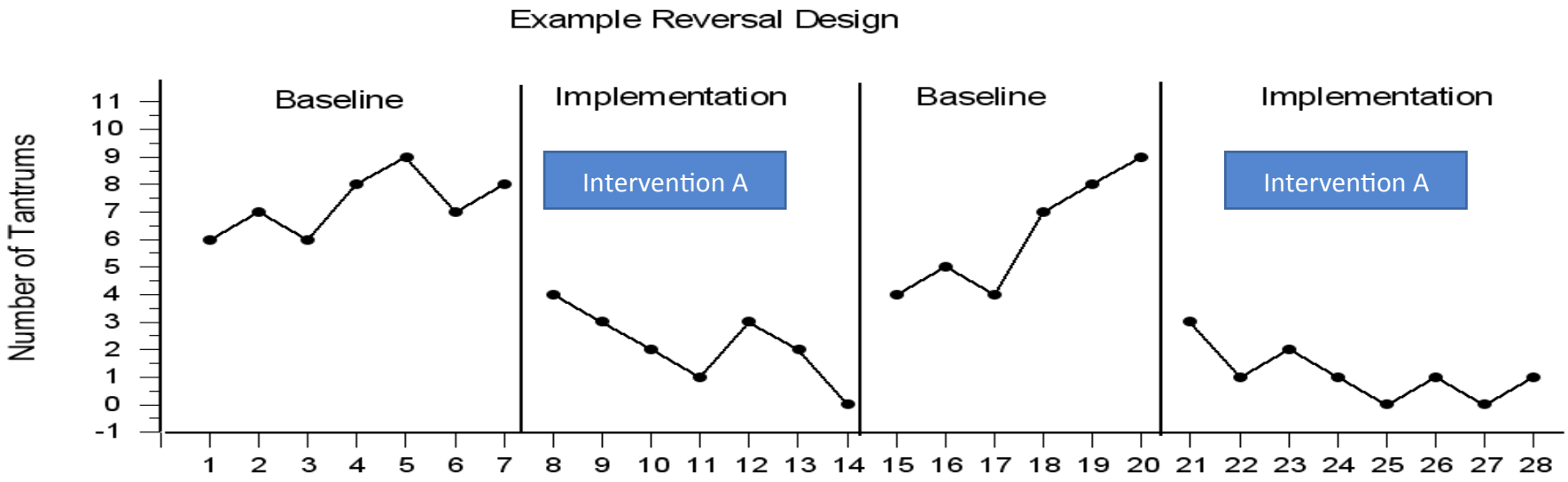
- The logic of a withdrawal or reversal is: if the behavior changes from the first baseline when the treatment is applied and then returns to levels seen during baseline when the treatment is withdrawn or reversed, then the changes can be attributed to the treatment.

- However, this is not very convincing.
- Only one replication of baseline and one opportunity for verification.
- If one cannot point out any plausible alternative reason for the behavior to change, the simple **ABA** design might be sufficient.
- But is it good for clinicians-leaving the client in baseline?????

- We can add to our conviction and be more therapeutic by:
  - Repeating the alternation between baseline and treatment





First Demonstration of Effect

Third Demonstration of Effect

Second Demonstration of Effect

Visual Analysis/Interpretation of Data

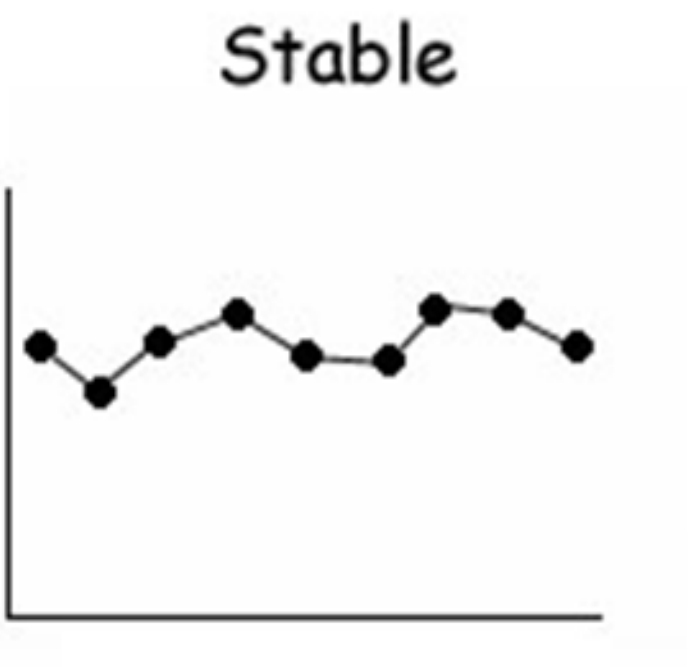
- Variability - the extent of change in the data from instance to instance
- Level - the extent of differences in central tendency of the data
- Trend - the overall direction and slope of change in the data

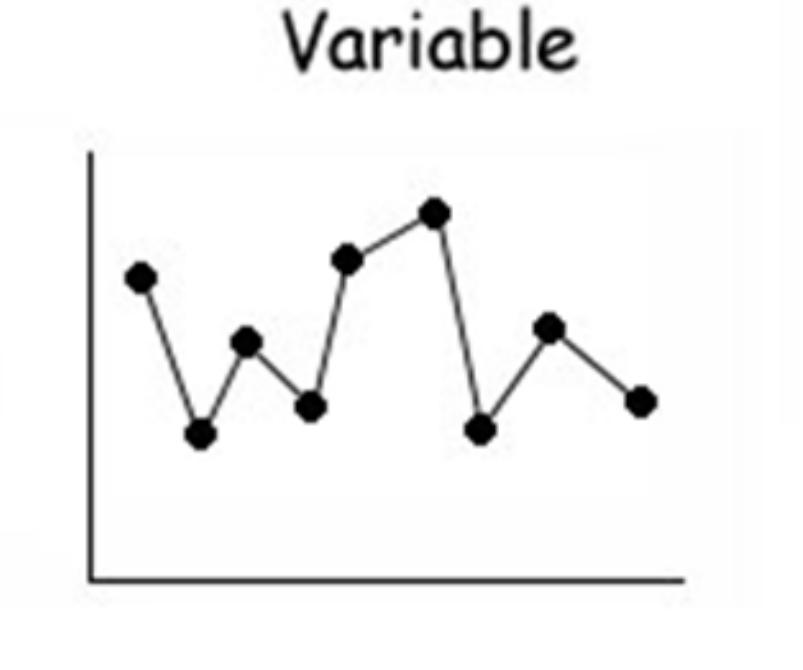
- Variability
  - Need a stable baseline data path before implementing a behavior change procedure
  - Need a stable data path after the behavior change procedure to indicate maintenance
  - If data are variable you may not be able to separate the influence of treatment versus other variables
  - Need more data if outcomes are variable

Variability of Data

- Lack of stability (lots of variability) suggests
  - a) operational definition not sufficient
  - b) variability in environmental factors over time
- Important term for variability: Range- distance between the largest and the smallest numbers in the data.
- But range is not sufficient
  - range does not show the instance to instance change that might occur over time.
  - range does not show trend
- Therefore we discuss levels of stability

Variability





Quantitative Definition of Stability

Example: # correct (16, 5, 9, 11, 10, 9)

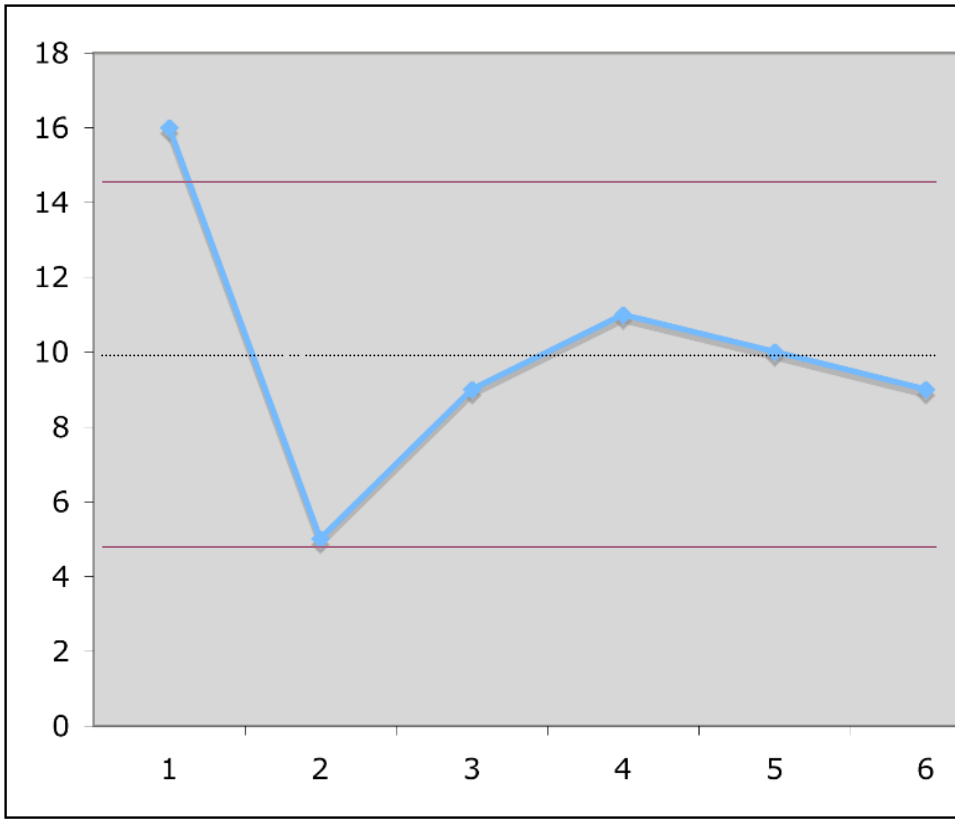
A. Find the mean (average) 60/6 = 10 (dashed line)

B. Divide the mean in half = 5

C. Add B to the mean for upper range & subtract B from the mean for lower range:

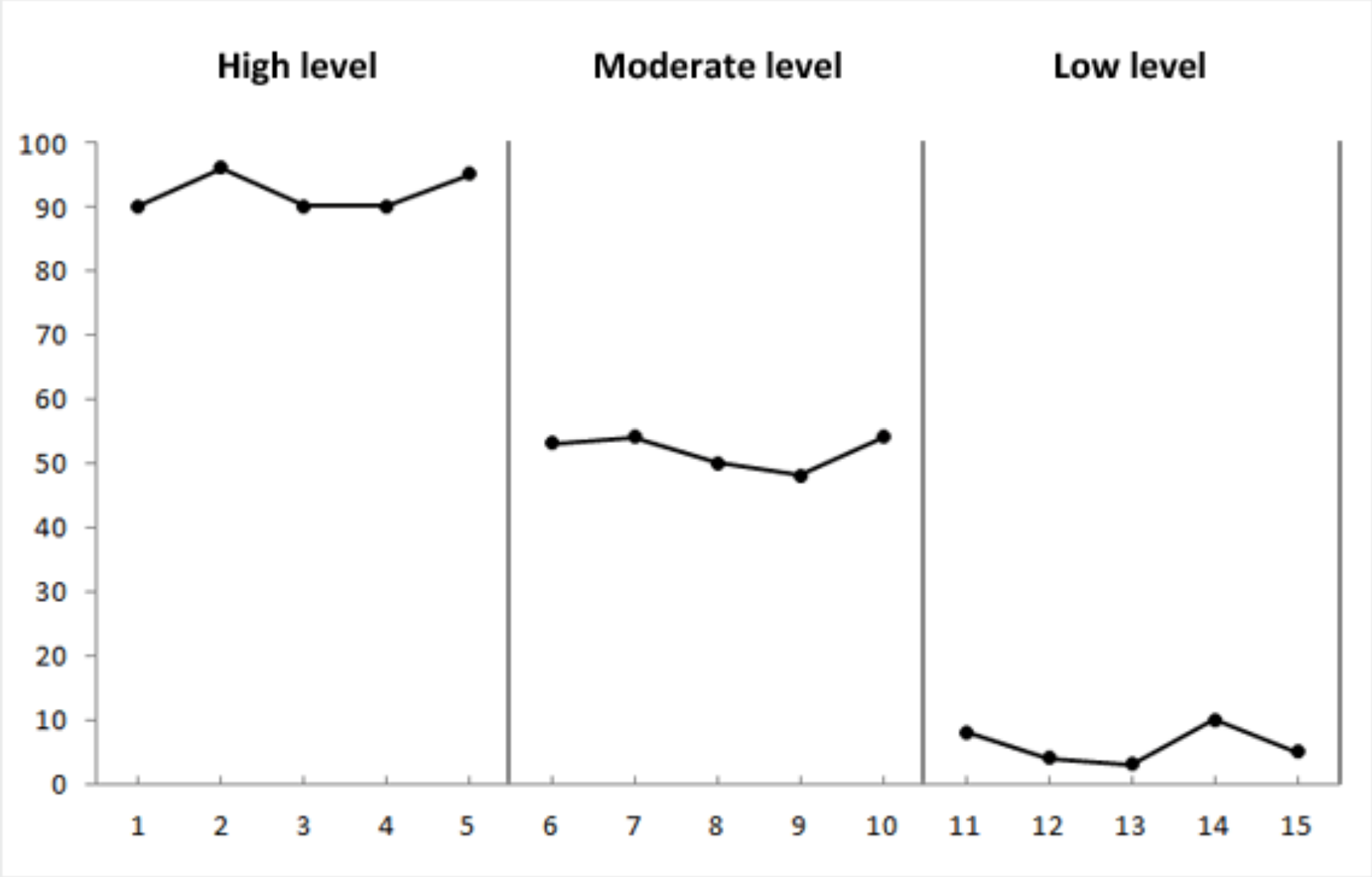
   15 and 5 (red lines)

D. Determine if all baseline data fall between the high & low range in C. In this case: No.



- Level
  - Often measured by central tendency of data along the y-axis scale, e.g., the mean.
  - Sometimes you graph the tendency with a dashed line representing the mean across a condition to compare level between conditions
  - Can be helpful with erratic behavior or with minor changes

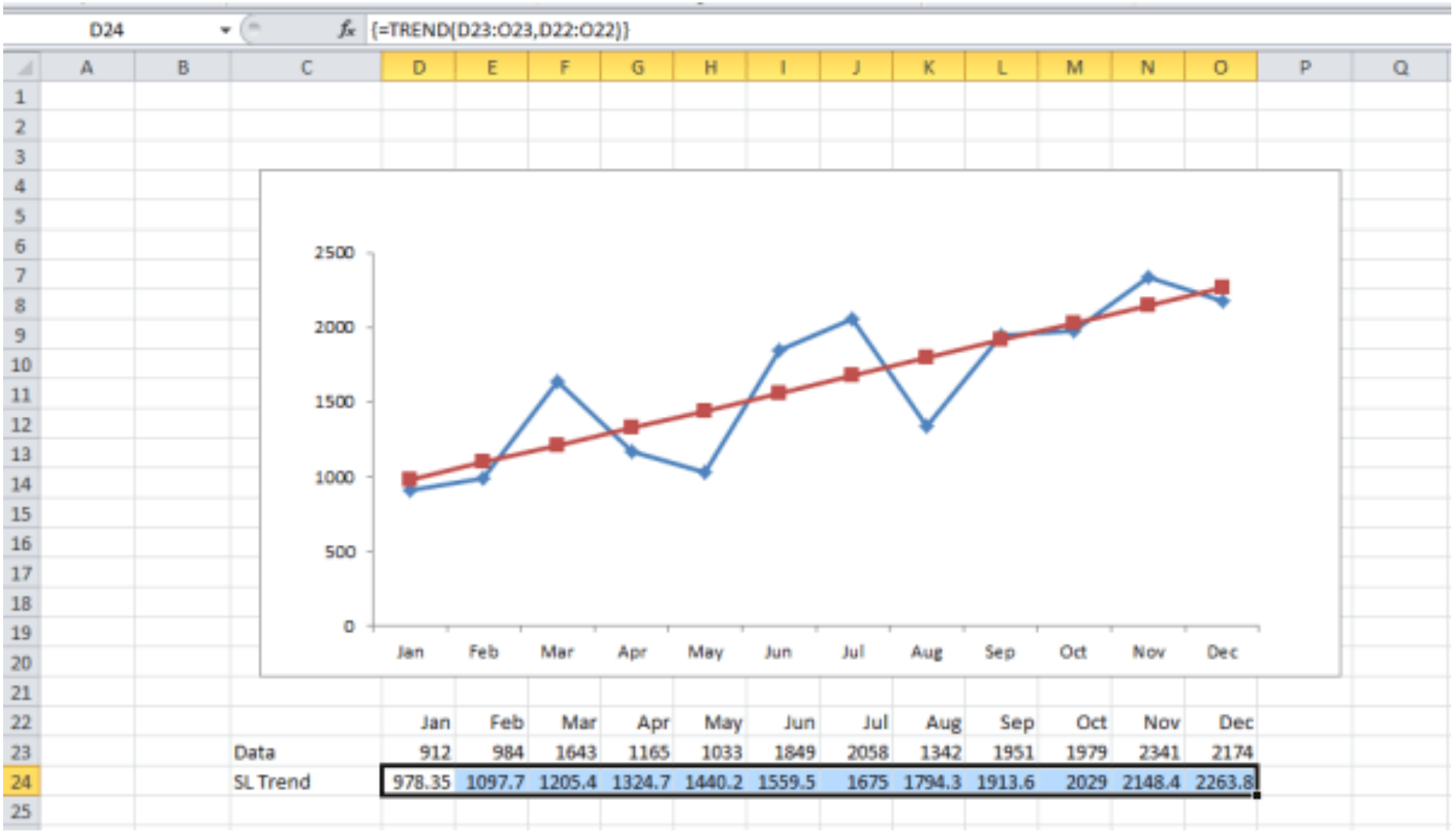
Level


High level
Moderate level
Low level
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Visual Analysis

- Level is also determined at the point between baseline and intervention-Does the level “jump”?
- Discontinuity: Word to use to indicate **change** in level between one phase and another
- Continuity: Word to use to indicate ***no change*** in level between one phase and the next
- Overlap: Word to describe the extent to which the range of numerical values are equal.

What does the red line indicate here?



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Data	912	984	1643	1165	1033	1849	2058	1342	1951	1979	2341	2174
SL Trend	978.35	1097.7	1205.4	1324.7	1440.2	1559.5	1675	1794.3	1913.6	2029	2148.4	2263.8

- Exactly: Trend
  - The overall direction and slope of change in the data path
  - Draw in a trend line from the beginning of the data to the end of the data (Use the split-middle line of progress outlined in Cooper or Excel Trend lines)

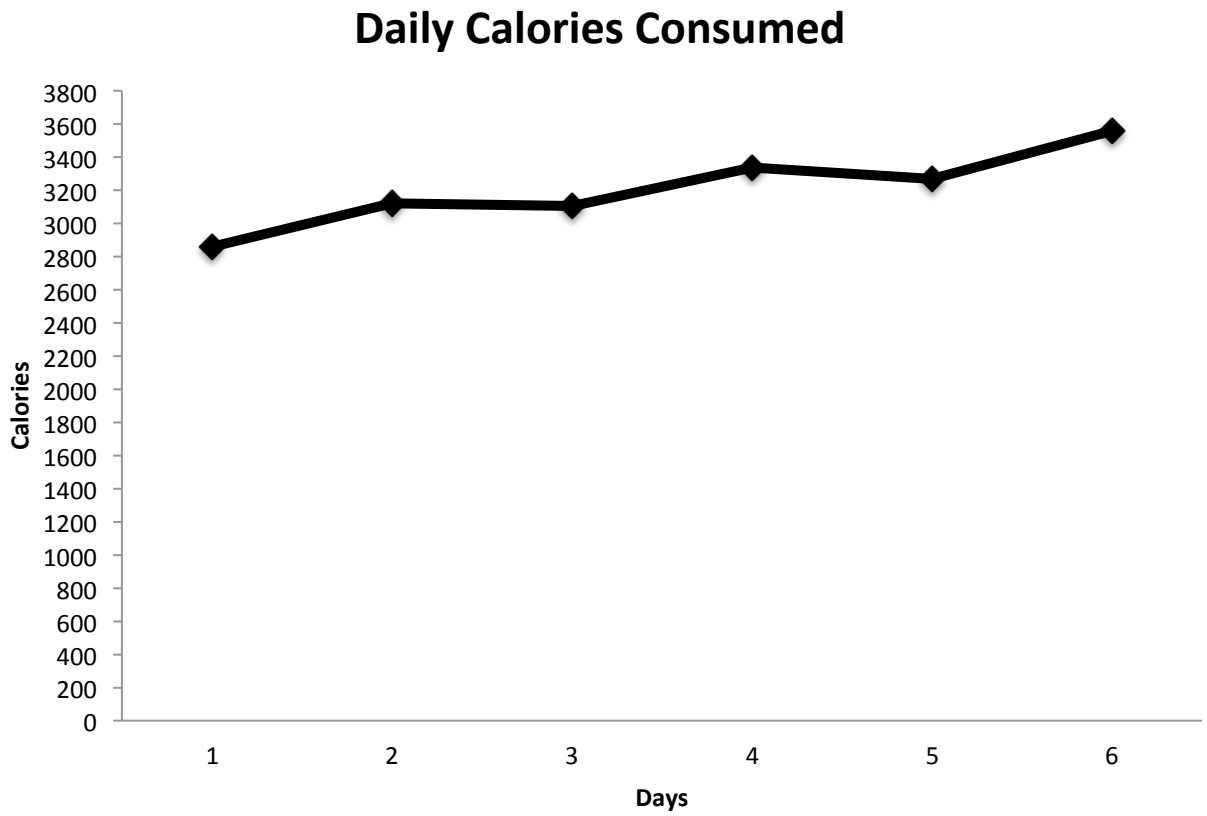
Trend

- Trend is used to make predictions and determine rate of learning (via slope)
- Sometimes defined as 3 successive data points in the same direction (Barlow & Hersen, 1984)

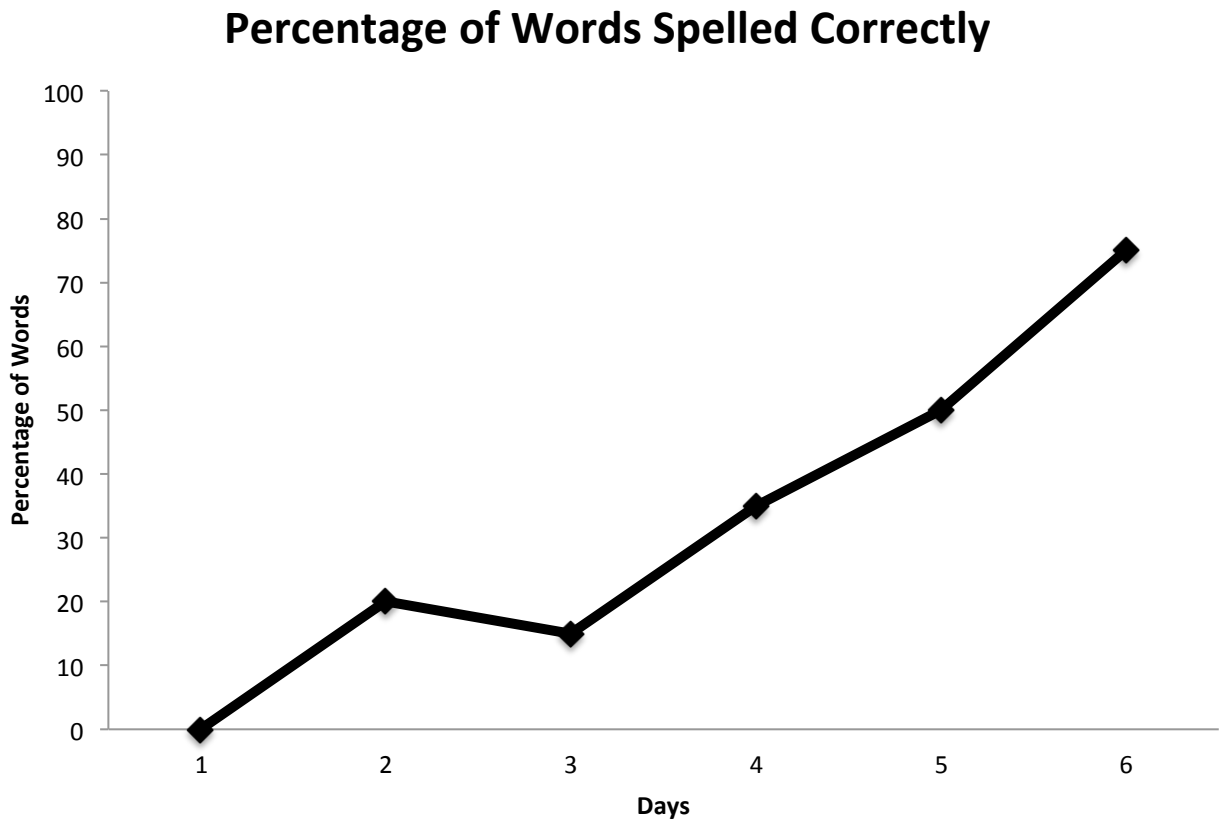
Describing trend

- Increasing, decreasing, or zero trend
- Gradual or steep

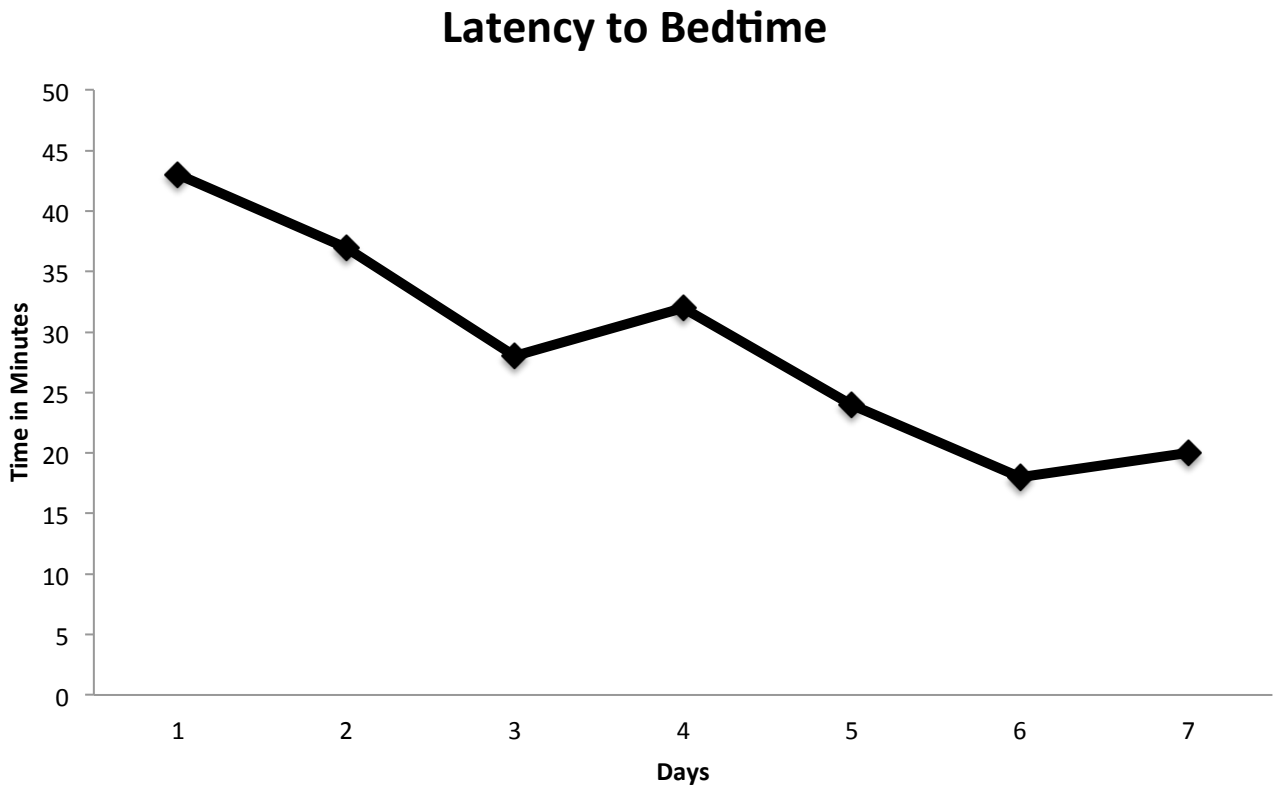
Gradual Increasing Trend



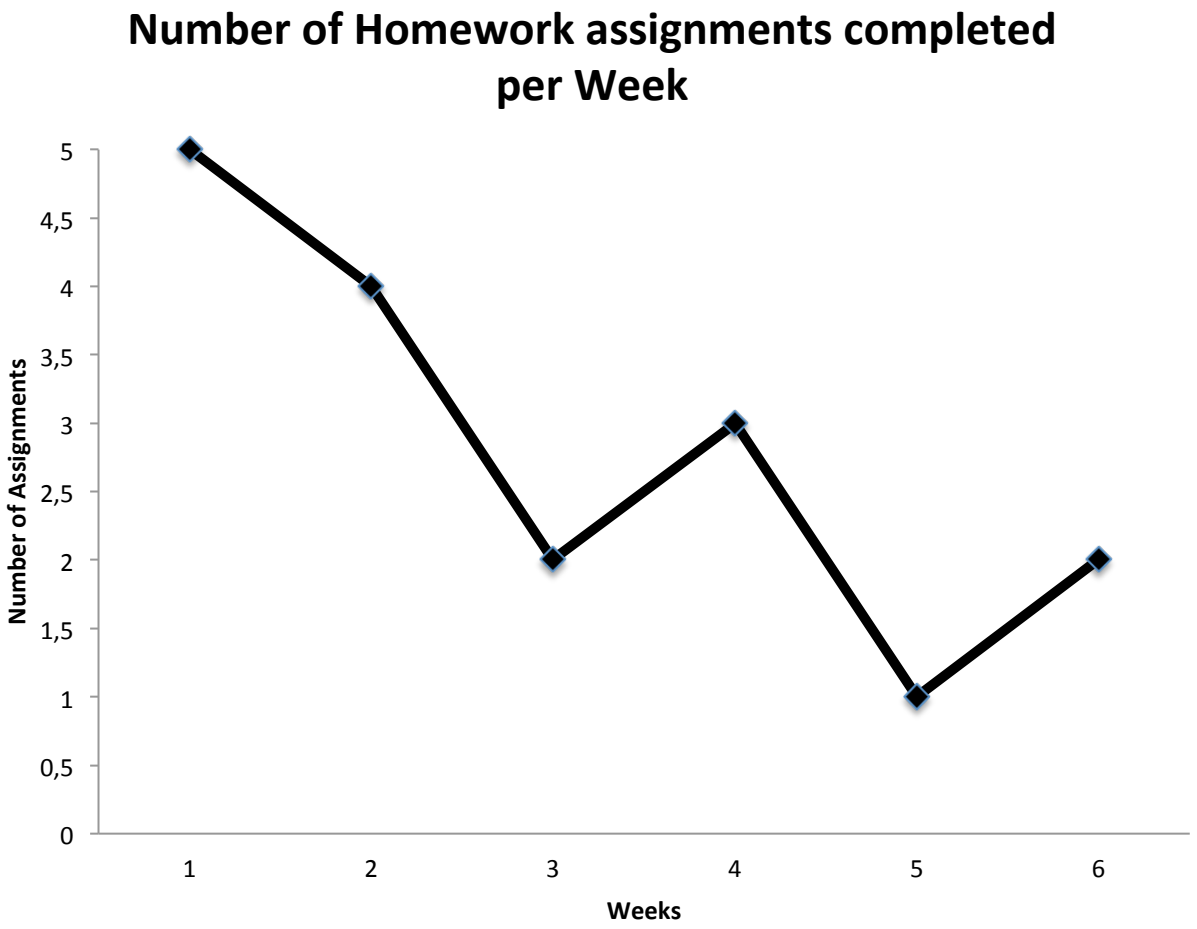
Steep Increasing Trend



Gradual Decreasing Trend



Steep Decreasing Trend

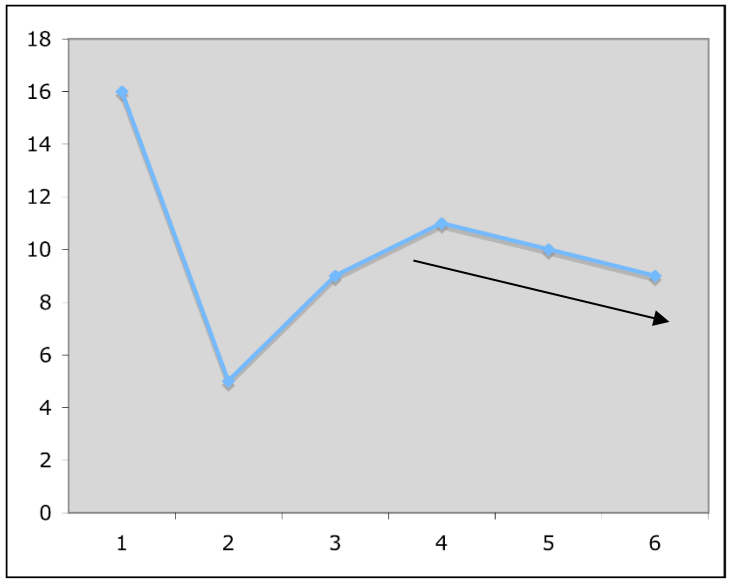


Trends used to evaluate baselines

- Whether the baseline is sufficient may also be based on how the data are trended - ascending or descending. “…3 successive data points in the same direction” (p. 121).

Examples:

If this graph is # correct on a spelling test, the trend is OK for an intervention because they are going in the opposite direction of what we seek - *increasing spelling performance*.



However, if this graph is # fights on the playground, the trend is NOT OK for an intervention because they are going in the direction of what we seek - *decreasing fights*.

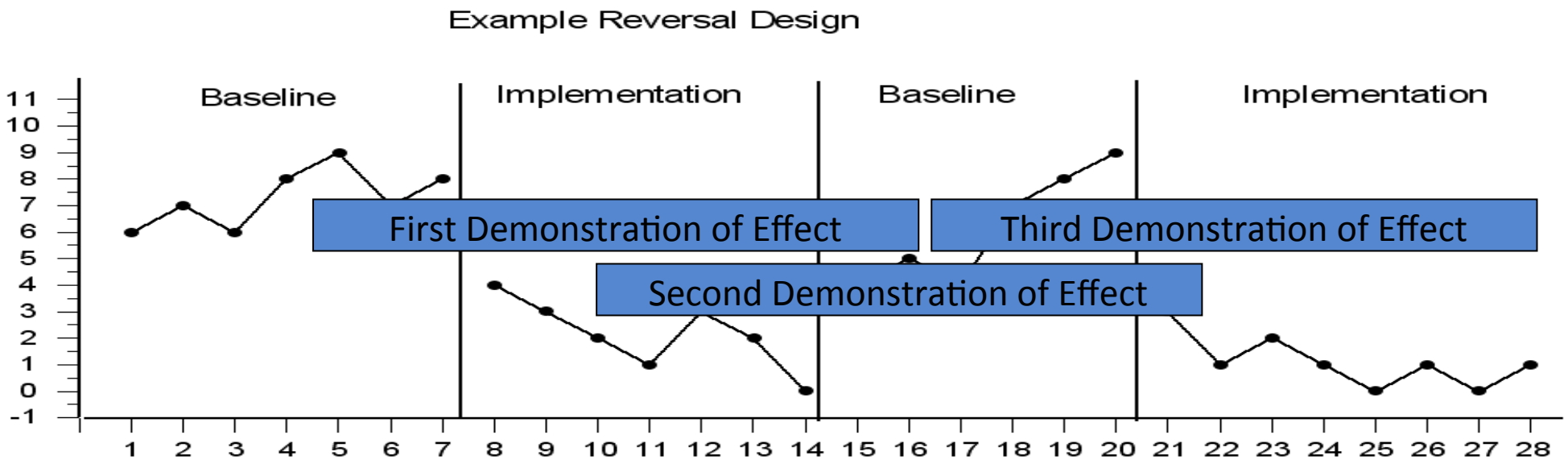
Developing Trend Lines

- Trend Lines in Excel
- Refer to YouTube Video or directions in your textbook.

Basic Patterns for Visual Analysis

- Whenever you look at a graph describe changes in :
  - Trend
  - Variability
  - Level
- As they compare across conditions.

Describe these data:



Graphing Reversal Data

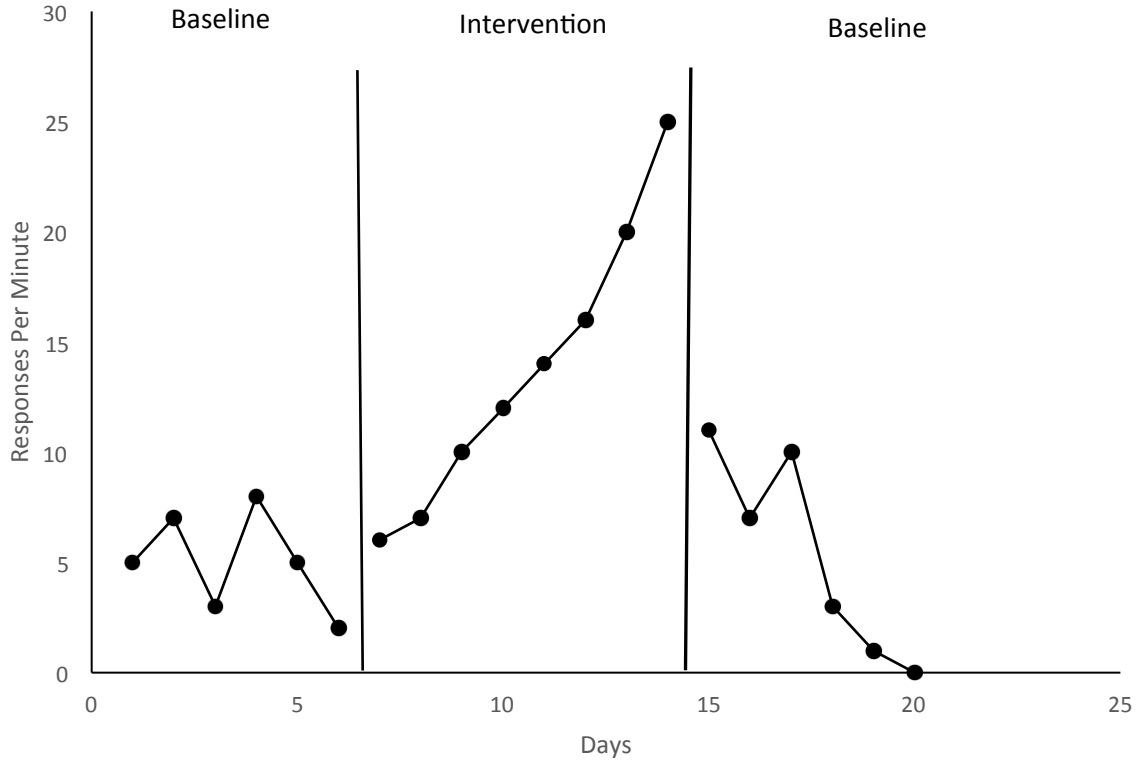


Figure 1. Responses per minute across days of baseline and intervention.

Graphing Elements

- X and Y axis and labels
- Condition change lines
- Condition labels
- Data points
- Data paths
- Figure caption

Writing the Results

- Results
  - Baseline 1
    - Figure 1 shows that the rate of correct responding was variable, but that the last three data points showed a downward trend. The mean level was 5 responses per minute.
  - Intervention 1
    - Figure 1 shows that the rate of correct responding increased by 4 responses per minute on the first day of intervention and continued with a steep increasing trend for the next seven days. The mean level for intervention 1 was 13.5 responses per minute.

Results Continued

- Baseline 2
  - With a return to baseline conditions, Figure 1 shows that the rate of correct responding decreased by 14 responses per minute and continued with a steep downward trend for the next 5 days. The mean level during the second baseline was 5.3 responses per minute.

Published Instructions for Graphing with Excel and other Software

- Dubuque (2015)
- Deochand, Costello, & Fuqua (2015)
- Deochand (2017)
- Chok (2018)
- Fuller & Dubuque (2018)
- Tyner & Fienup (2016)

Teams-Graphing

	Graphing Exercise			
	Baseline	Treatment	Baseline	Treatment
	5	0	22	10
	7	2	33	12
	3	1	15	14
	8	0	17	8
	5	3	15	5
	2	2	15	3
	6	3	20	2
	7	4	16	2
	10	2	16	5
	12	2	20	2

Do the following:

- Using the data from the previous slide construct an ABAB graph. If you know how to use Excel draw the figure with Excel. Otherwise, draw the figure by hand.
- Include all components:
  - X and Y axis and labels
  - Condition change lines
  - Condition labels
  - Data points
  - Data paths
  - Figure caption

Also:

- Write a short results section describing the following:
  - Levels
  - Trends
  - Variability
  - Comparisons among conditions

Further Questions

- Say how a reversal/withdrawal design like the one you just created helps establish the internal validity of the relations between an independent variable and a dependent variable.
- Name and describe each of the kinds of replication discussed in these slides.

Problems with Reversal Designs

- Ethics
- Irreversibility
- Multiple- treatments

http://www.art.com

Problems with ethics?

- Biggest problem is with stability criterion:
  - Should you wait until behavior is stable in baseline?
  - What if it is life threatening?
  - SIB?
  - Parents want to see quick change.
  - Insurance or government regulations want to see quick change

Self-mutilation in the Gulag, using explosives. Painting by Nikolai Getman, provided by Jamestown Foundation

Ethics of Replication

- The second ethical problem is whether you should stop a treatment that is effective.
- Should you reverse to baseline conditions when you see improvement in the subjects performance?
- Again ask this of life threatening behaviors like SIB.
- But also true for other kinds of behavior.

We have to be practical and consider social validity

- If the behavior is life threatening
- If the behavior is pivotal-needed to go forward with a program
- If it has been difficult to convince others that experimental demonstration is something good
- …then you might have to use a different design

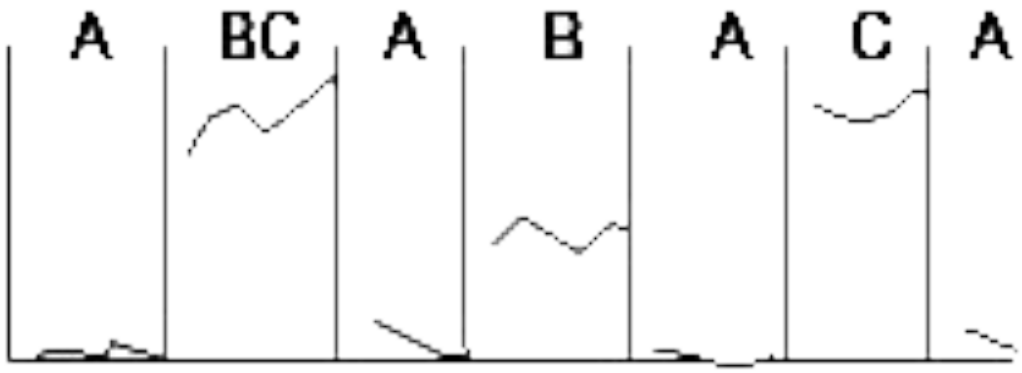
Problems with Irreversibility

- Some behaviors also do not reverse.
- Reversal or withdrawal designs are good for manipulating reinforcers and punishers.
- Not so good for reversing teaching, acquisition, or instructional variables, like a curriculum or a set of rules or instructions.

Problems with Multiple-treatments

- Reversal designs are most clear when there is one change from baseline to treatment
- But what about evaluating multiple treatments?

Special case of withdrawal design



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- Can also be examined by an ABABACAC etc., where each treatment is compared to the baseline.
- But in many cases there is a history effect: C has a different effect after subject has had a history of B.
- Example: High frequency of reinforcement will be more effective after a history of low reinforcement.
- Called carry over effects, sequence effects or multiple treatment interference

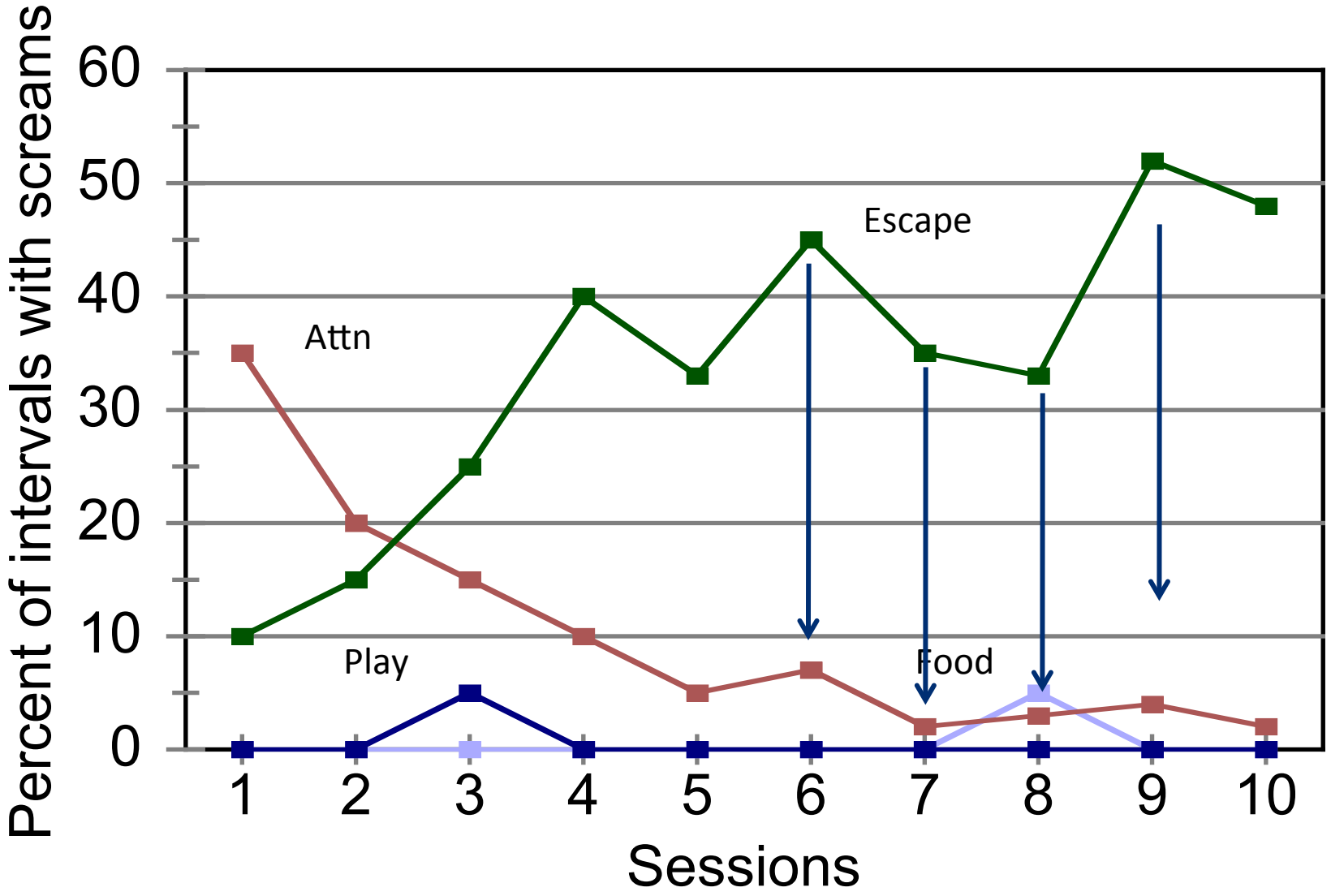
Alternating Treatment Design

- The design is based on the same logic as a reversal, but has some features that minimize problems.
- It is called an alternating treatment design or a multi-element design.

Alternating Treatment Design

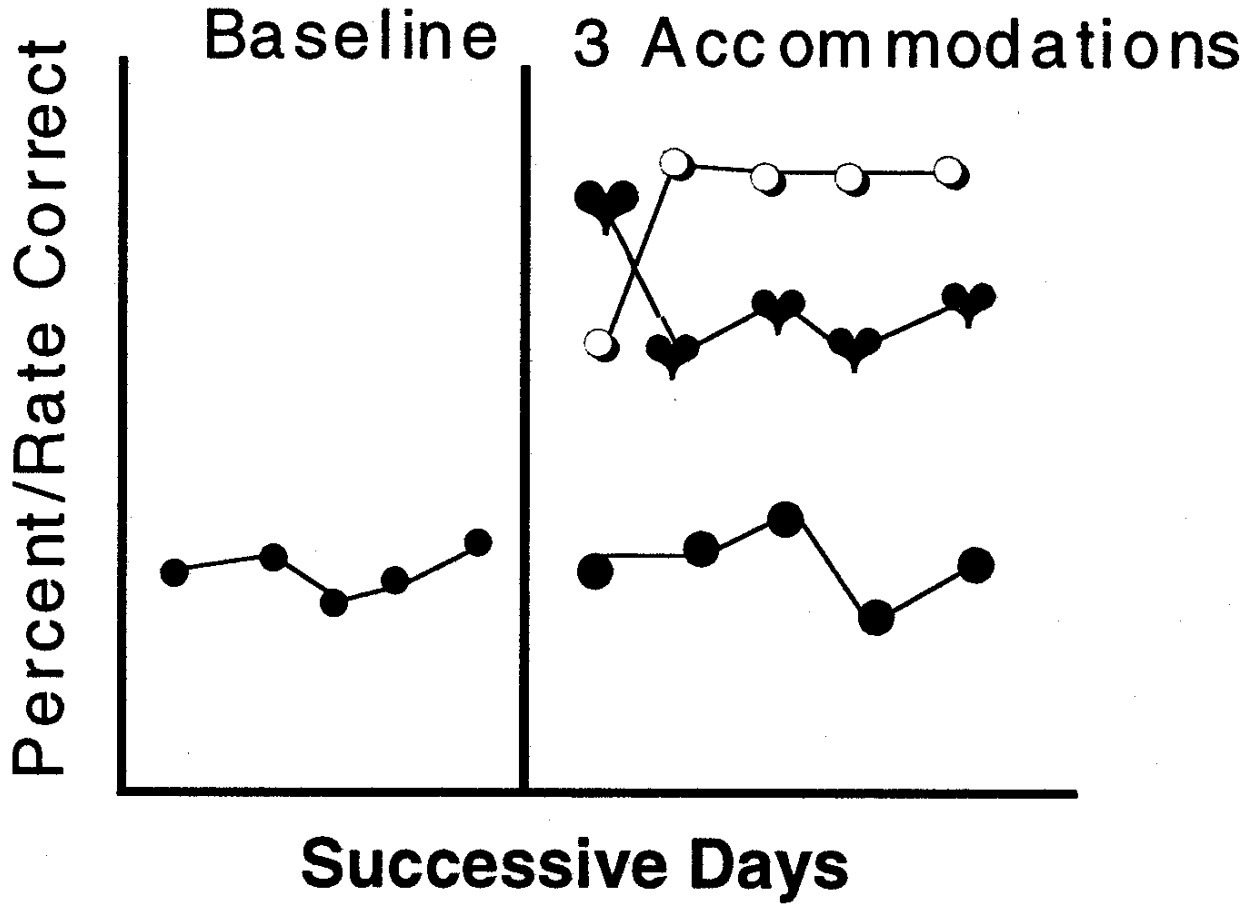
- An alternating treatment design involves the rapid varying or alternation among conditions
- Although baseline data might be collected, stability is not required, nor are baseline replications

Felix

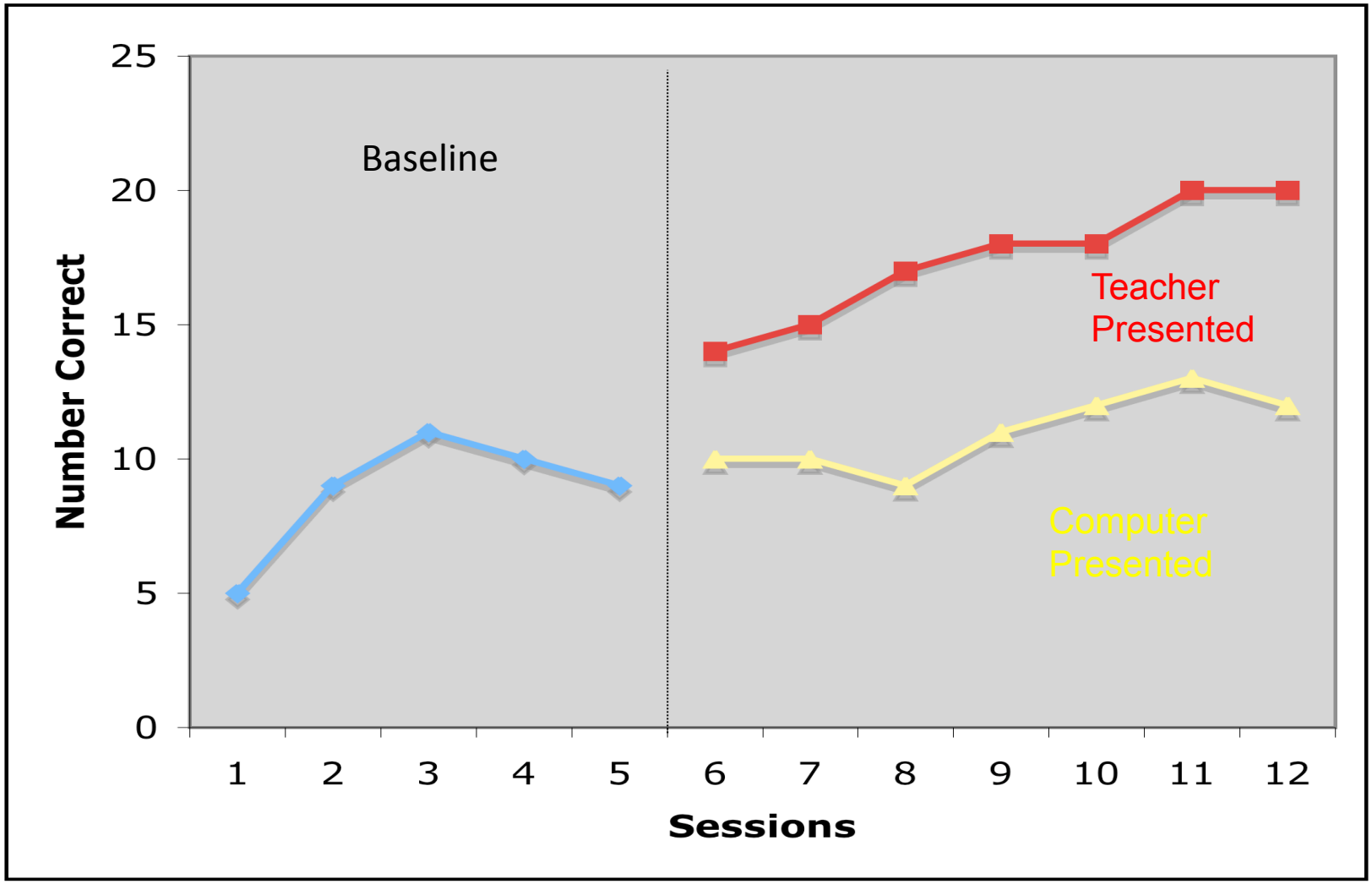

Percent of intervals with screams
60
50
40
30
20
10
0
Attn
Escape
Play
Food
1
2
3
4
5
6
7
8
9
10
Sessions

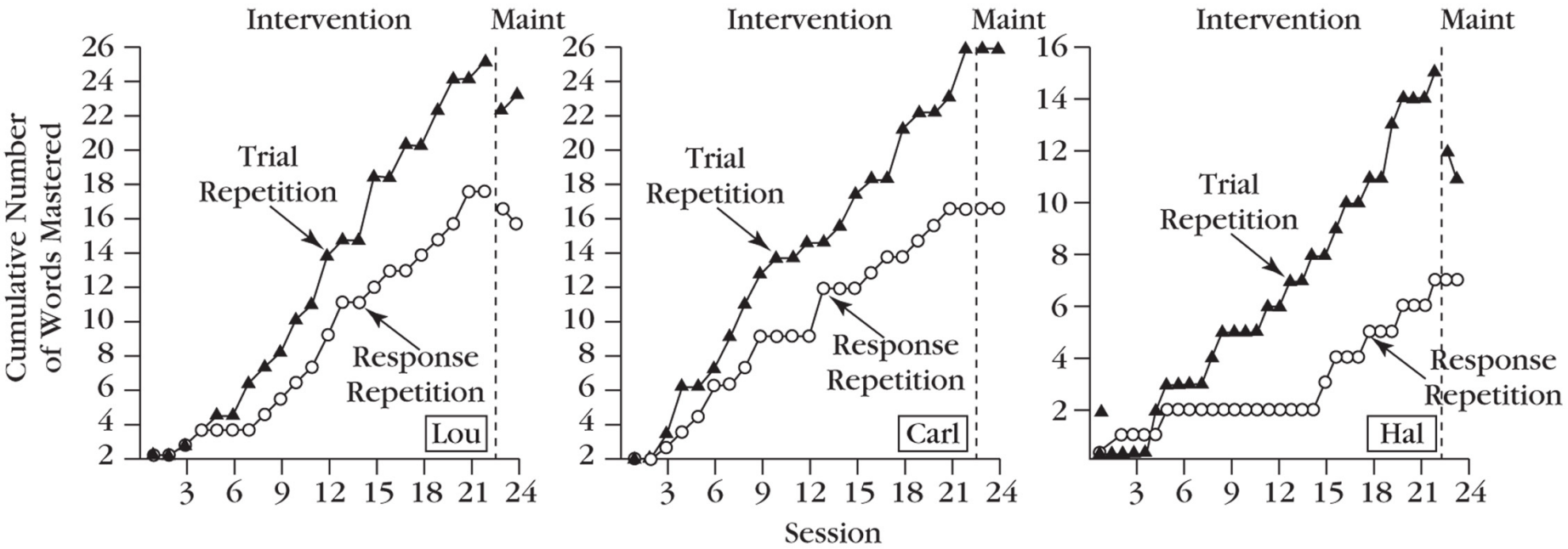
- Minimizes the ethical problems of stability requirements
- Minimizes the problem of order effects because orders can be varied or randomized or manipulated directly to test for order or carry over effects

Alternating Treatments design



Baseline Followed by ATD




Intervention
Maint
Cumulative Number of Words Mastered
Trial Repetition
Response Repetition
Lou
Carl
Hal
Session
2
4
6
8
10
12
14
16
18
20
22
24
26
3
6
9
12
15
18
21
24

Advantages

- No stability so one can introduce treatment quickly
- Order effects can be evaluated quickly by randomly presenting different orders and examining effects.
- Doesn’t minimize problems of reversibility.

Synonyms for Alternating Treatment Design

- Also known as:
  - Multi-element design
  - Multiple schedule design
  - Concurrent schedule design
  - Simultaneous treatment design

Need other experimental designs

- These last two problems require other designs which will be our next lesson.
- But before we progress…

Teams: Graphing Alternating Treatment Data

- Graph the data in the next slide and include all the elements of a figure that we have described including the figure caption. If you know how to use Excel, draw the figure with Excel. Otherwise, draw it by hand.

Graph these Data

Baseline	Self Stimulation	Escape	Attention
10			
12			
12			
11			
	12	2	4
	2	3	2
	14	1	4
	16	2	3