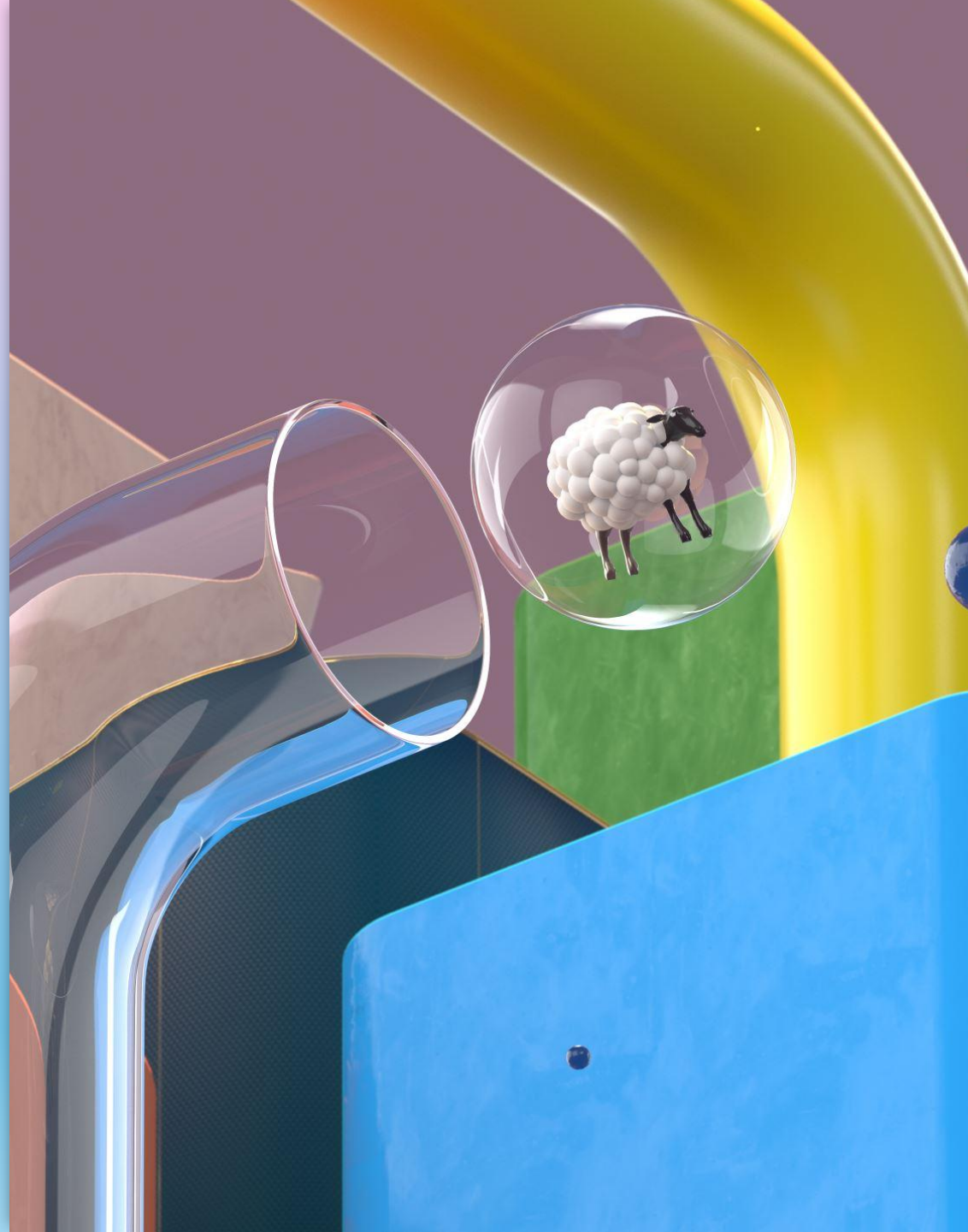
Single-Subject Experimental Design for Evidence-Based Practice

- Byiers, B. J., Reichle, J., & Symons, F. J. (2012)



Introduction to SSED

Definition: Single-subject experimental designs (SSEDs) focus on studying individual behavior changes to evaluate interventions.

Relevance: Used extensively in evidence-based practices for speech-language pathology, psychology, and special education.

Purpose of SSED

- Assess Individual Behavior Changes
- Establish Functional Relationships
- Supports Evidence-Based Practice
- Flexible and Adaptable

Key Features

- Use of repeated measures.
- Baseline-intervention comparison.
- Emphasis on experimental control.

Table 2. Summary of single-subject experimental designs (SSEDs) (Byiers et al., 2012, p. 401).

Design	Research questions	Advantages	Disadvantages
Pre-experimental (AB)	Does outcome X change from baseline levels with the introduction of intervention B?	• Quick and efficient to implement. • Appropriate for low-stakes decision making.	• Does not control for threats to internal validity; not an experimental design.
Withdrawal (ABA/ABAB)	Does outcome X covary with introduction and withdrawal of intervention B?	• Easy to implement, strong experimental control when effects are immediate and large.	• There are ethical considerations regarding withdrawing or reversing a potentially effective intervention. • Not all behaviors are "reversible."
Multiple-baseline/multiple-probe	Does outcome X change from baseline levels with the introduction of intervention B over multiple participants, responses, settings, etc.?	• Does not require withdrawal of intervention. • Appropriate for nonreversible behaviors.	• Ethical considerations regarding keeping individuals/behaviors in baseline conditions for a long period. • Requires multiple individuals, responses, settings, etc., that are comparable in order to replicate effects.
Changing-criterion	Do changes in the level of outcome X correspond to changes in the intervention criteria?	• Does not require reversal. • Appropriate for behaviors that can be changed gradually. • Useful for consequence-based interventions.	• Change must take place in graduated steps; not appropriate for behaviors that require immediate change. • Requires the use of incentive- or consequence-based interventions.
Multiple-treatment	What are the relative effects of interventions A and B (and C, D, etc.) on outcome X compared to each other and/or baseline levels?	• Can be extended to compare any number of interventions or variables. • Can extend a withdrawal study when effects of initial intervention are not as pronounced as expected. • Can be used to conduct component analyses of necessary and sufficient intervention components.	• Behaviors should be reversible to demonstrate relative effects. • Only comparisons between adjacent conditions are appropriate. • Can be time consuming and complicated to implement when the number of interventions being compared increases. • Results are susceptible to multiple treatment interference.
Alternating treatments	What are the relative effects of interventions A and B (and C, D, etc.) on outcome X compared with each other and/or baseline levels?	• Can be extended to compare any number of interventions or variables. • Can provide strong experimental evidence in relatively few sessions.	• Behaviors must be readily reversible to obtain differentiation between conditions. • Results are susceptible to multiple treatment interference.
Adapted alternating treatments	What are the relative effects of intervention A on outcome X and intervention B on outcome Y?	• Less prone to multiple treatment interference. • Can provide strong experimental evidence in relatively few sessions. • Does not require reversal.	• Set of behaviors or stimuli must be directly comparable for effects to be meaningful. • Potential generalization across behaviors must be considered.

Six primary design types are discussed (Byiers et al., 2012, p. 401).

- The pre-experimental (or AB) design
- The withdrawal (or ABA/ABAB) design
- The multiple-baseline/multiple-probe design
- The changing-criterion design
- The multiple-treatment design
- The alternating treatments and adapted alternating treatments designs (see Table 2).

AB DESIGN

•Another name for an **A-B design is a pretest-posttest design or baseline-treatment design** in behavior analysis and research. It involves two phases:

1. **A Phase (Baseline)**: Behavior is measured without any intervention to establish a baseline.
2. **B Phase (Intervention)**: Behavior is measured during the application of an intervention.

•This design is straightforward but lacks the experimental control to rule out alternative explanations for changes in behavior, as it does not include a return-to-baseline or reversal phase like more rigorous designs (e.g., A-B-A or A-B-A-B designs).

AB Design Example

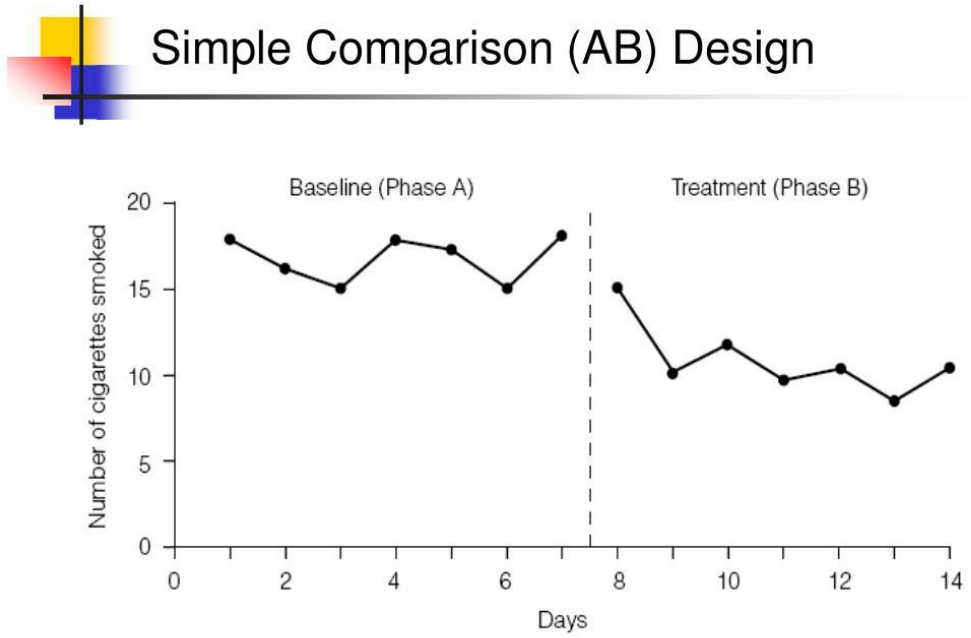
(https://image3.slideserve.com/6586085/slide17-l.jpg)

•This graph shows an **AB Design**, with **Baseline Phase A** on the left and **Treatment Phase B** on the right. The X-axis represents **days**, and the Y-axis represents **cigarettes smoked**.

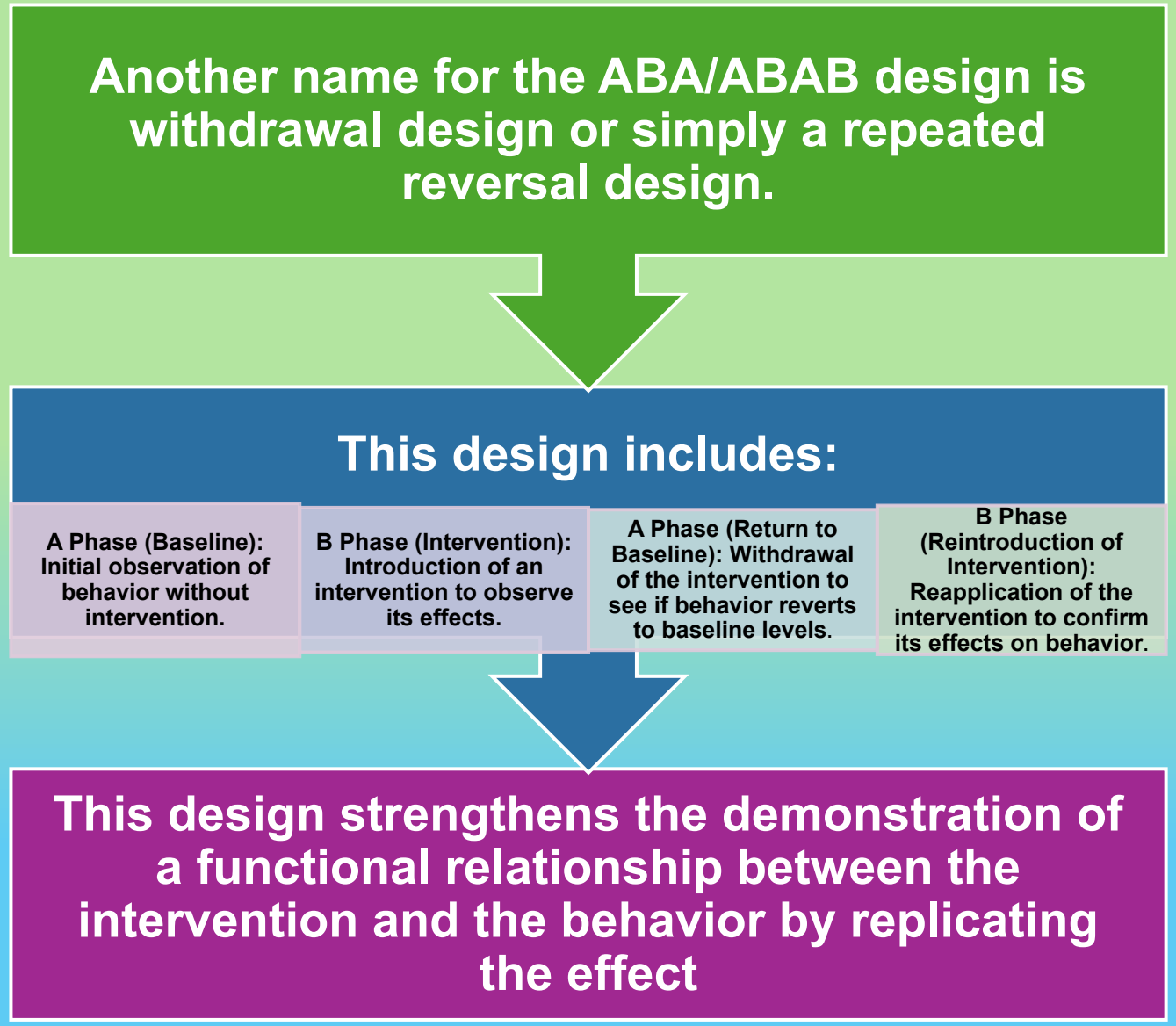
•**Baseline Phase (Phase A):** The number of cigarettes smoked remains stable between 15-20 per day, showing no significant change.

•**Treatment Phase (Phase B):** After the intervention starts (indicated by the dashed line), the number of cigarettes smoked drops to 5-10 per day, indicating the intervention's effectiveness.

•**Conclusion:** The intervention effectively reduced the behavior, as evidenced by the sharp decrease in smoking during Phase B.



The Withdrawal/Reversal (ABA/ABAB Design:) Design



The Withdrawal (ABAB) design

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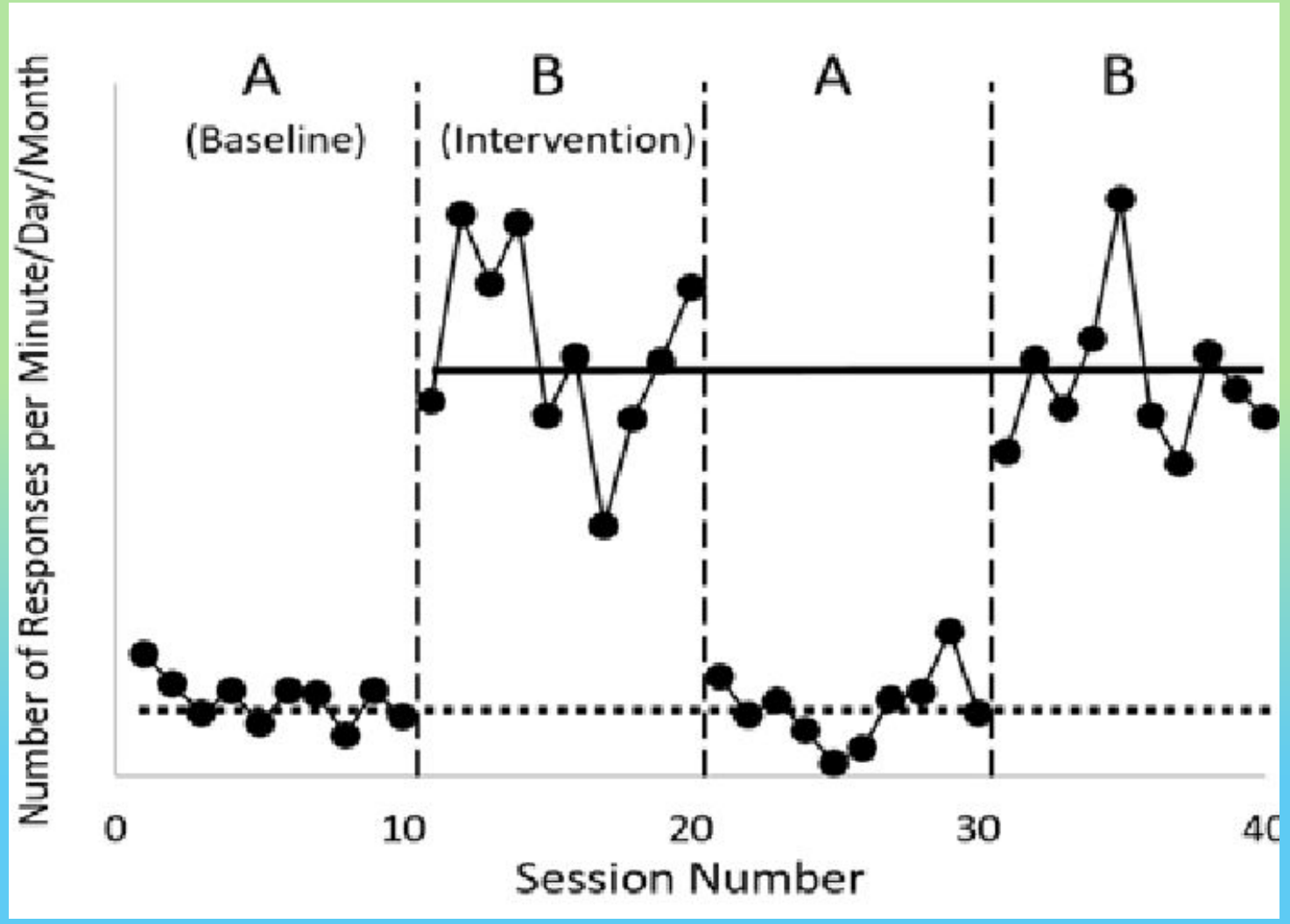
- The dashed line represents the expected rate of responding if the initial baseline condition (A) were to be continued across all 40 sessions.
- The solid line represents the expected rate of responding if the first intervention condition (B) were to be continued for the remaining sessions.



Multiple Baseline Design & Multiple Probe Design

Multiple Baseline Design (MBD) & Multiple Probe Design: Definition:

- MBD: A single-subject experimental design used to assess the effects of an intervention across different behaviors, settings, or individuals, sequentially.
- Multiple Probe Design: A variation of MBD that uses intermittent data collection instead of continuous baseline measurement.

Key Features:

- **MBD:** Baseline data are collected for multiple behaviors/settings/individuals, with the intervention introduced at different times for each baseline.
- **Multiple Probe Design:** Baseline data are collected intermittently (e.g., probes), reducing data collection burden.

Strengths:

- **MBD:** Can demonstrate functional relationships without the need for treatment withdrawal.
- **Multiple Probe Design:** Useful for situations where continuous baseline data is impractical, but intervention effects still need to be assessed.

Limitations:

- **MBD:** May require long time frames and does not allow for randomization.
- **Multiple Probe Design:** May miss small changes in behavior and be less sensitive than continuous baseline designs.

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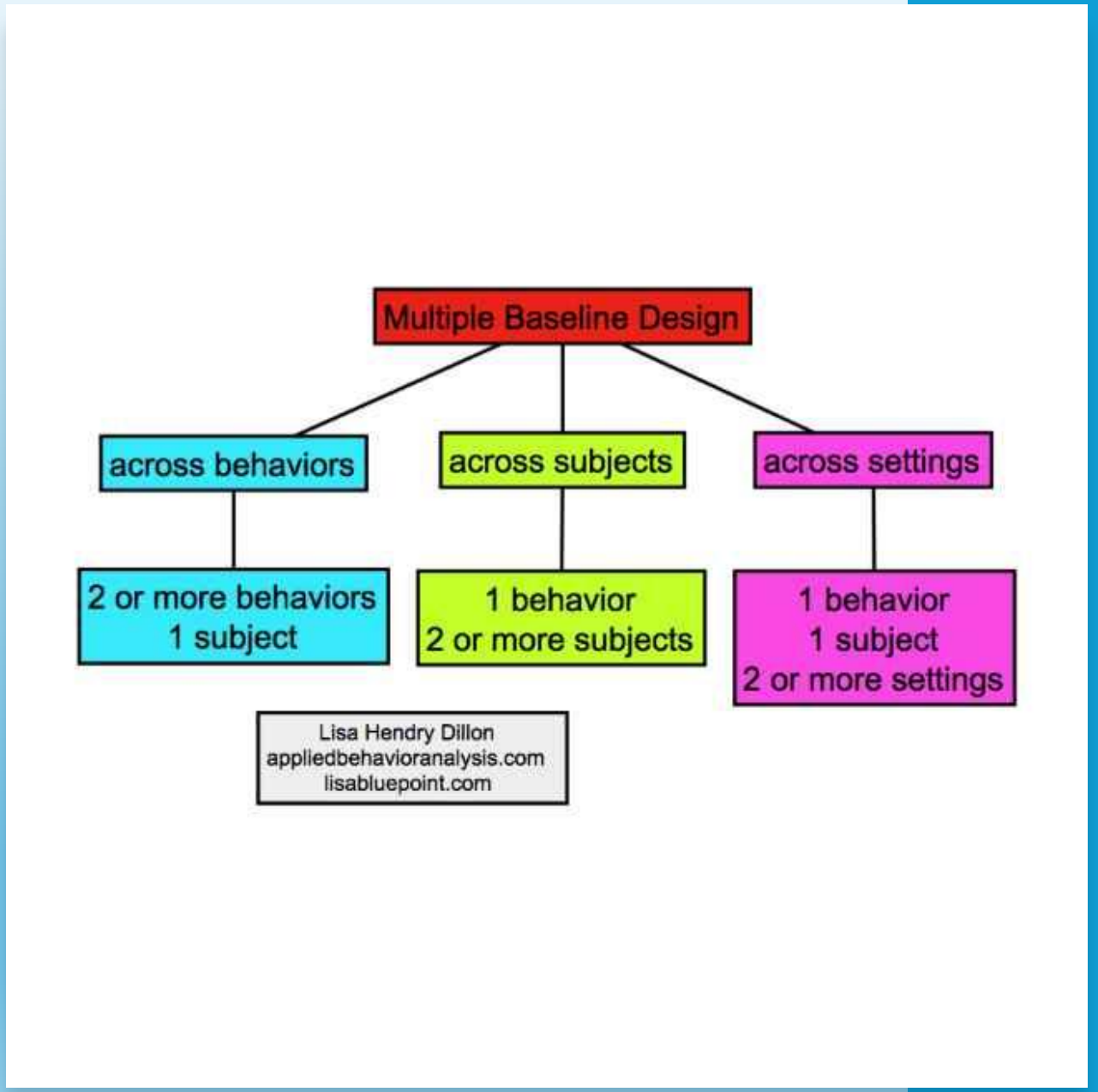
Multiple Baseline Design Example continued



Example of Multiple Baseline Design – Across Behaviors

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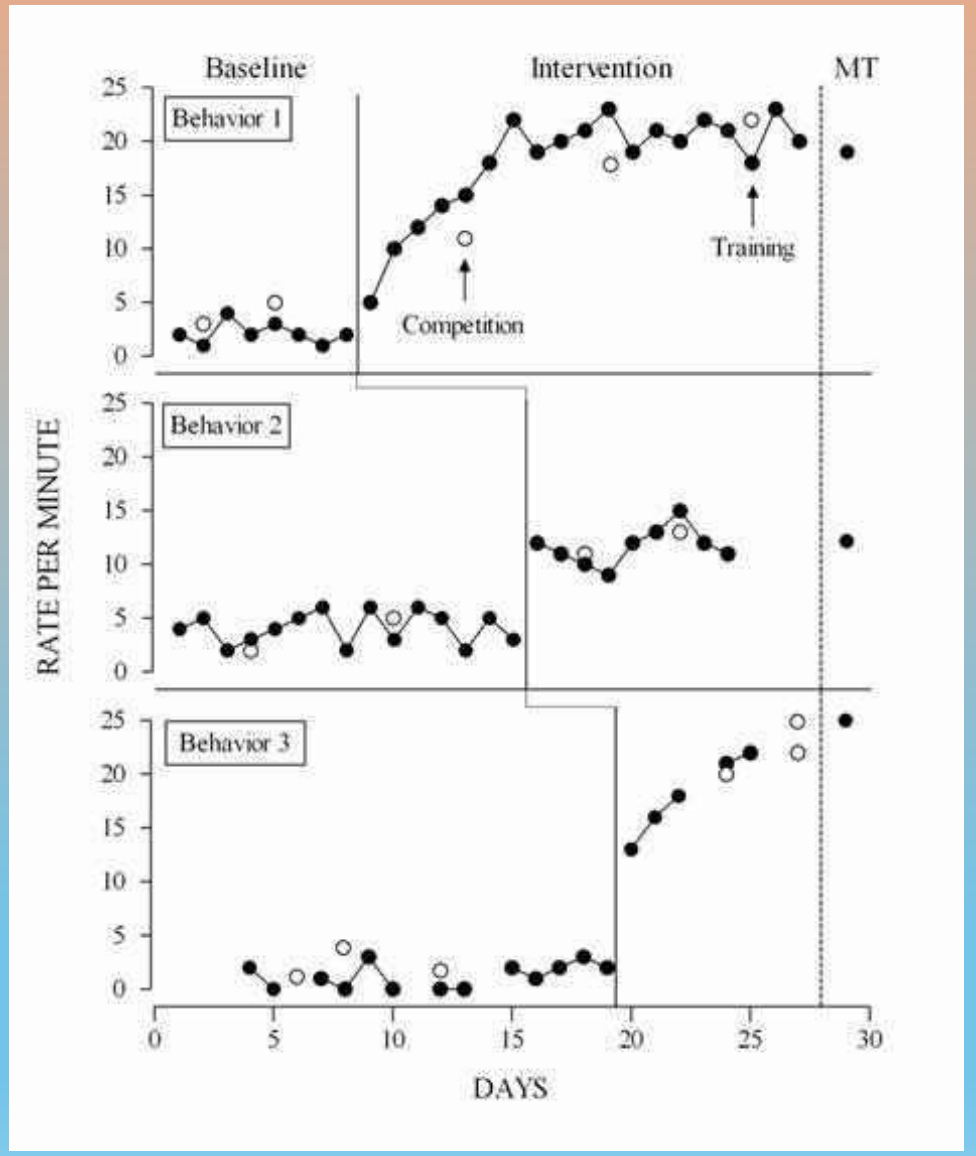
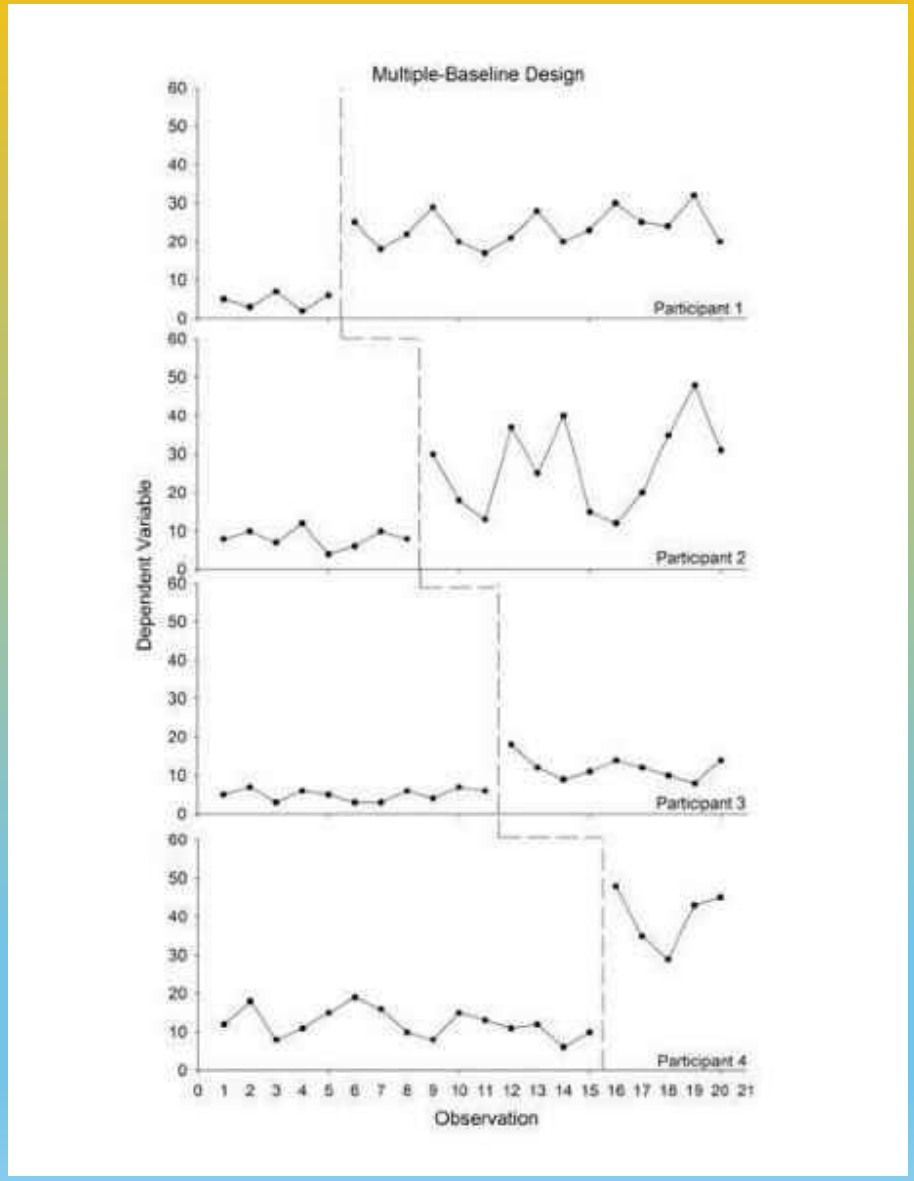


Example of Multiple Baseline Design-Across Subjects

- [Example of a multiple baseline design showing experimental control and... | Download Scientific Diagram]



Example of Multiple Baseline Design – Across Settings

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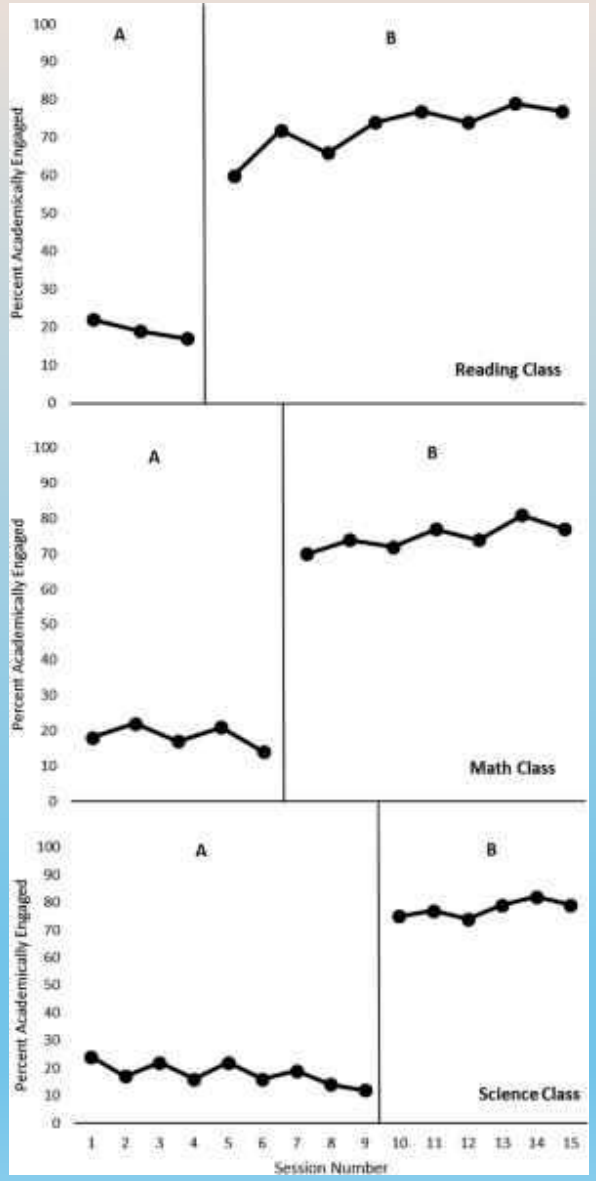

Changing Criterion Design

Another name for changing criterion designs is shaping criterion designs or graduated criterion designs.

Key Features:

- **This design involves gradually changing the criteria for reinforcement or behavior goals over time. It is typically used when behavior is expected to improve incrementally.**
- **The design allows for the systematic evaluation of behavior change as the criteria for success become progressively more stringent.**
- **It is particularly useful for teaching behaviors that need to increase or decrease gradually (e.g., increasing response rates or reducing undesired behaviors in a step-by-step manner).**

Changing Criterion Design Example

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- **Behavior Contract**: The intervention, in this case, is a **behavior contract** that outlines specific goals and consequences. The contract likely ties reinforcement to meeting the criteria for each goal, encouraging behavior change across the sessions.
- **Goal Phases**: The gradual tightening of criteria from **Goal 1** through **Goal 5** allows for small, manageable steps that progressively reduce inappropriate comments. Each goal sets a new benchmark for acceptable behavior.
- **Decreasing Trend**: The graph shows that as the adolescent moves through each phase, the frequency of inappropriate comments consistently decreases, indicating the intervention's effectiveness in shaping behavior.

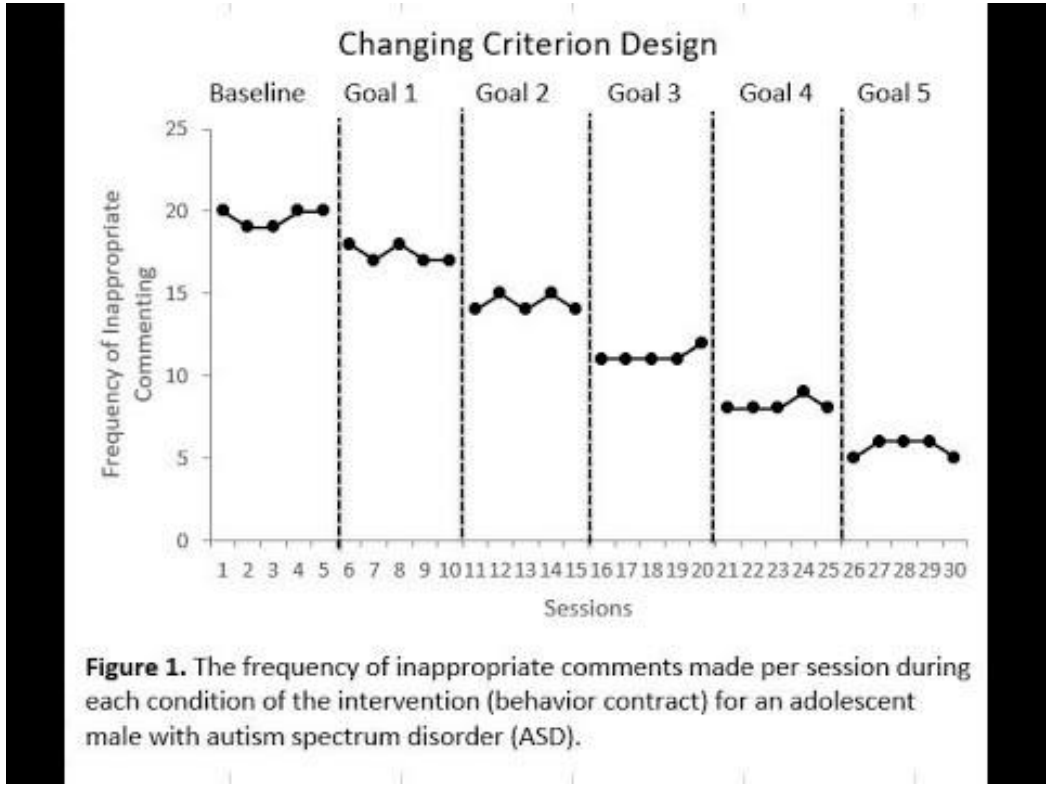
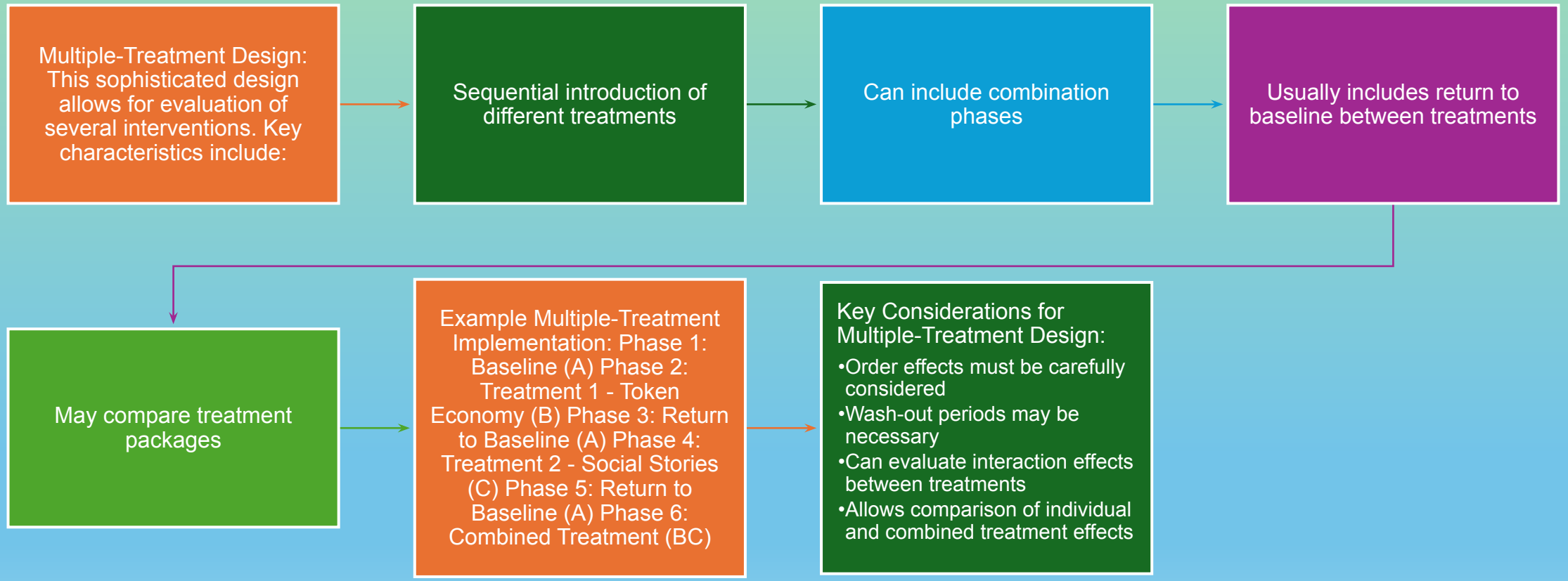


Figure 1. The frequency of inappropriate comments made per session during each condition of the intervention (behavior contract) for an adolescent male with autism spectrum disorder (ASD).

The Multiple Treatment Design



The Multiple-Treatment Design Example

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Alternating Treatment Designs

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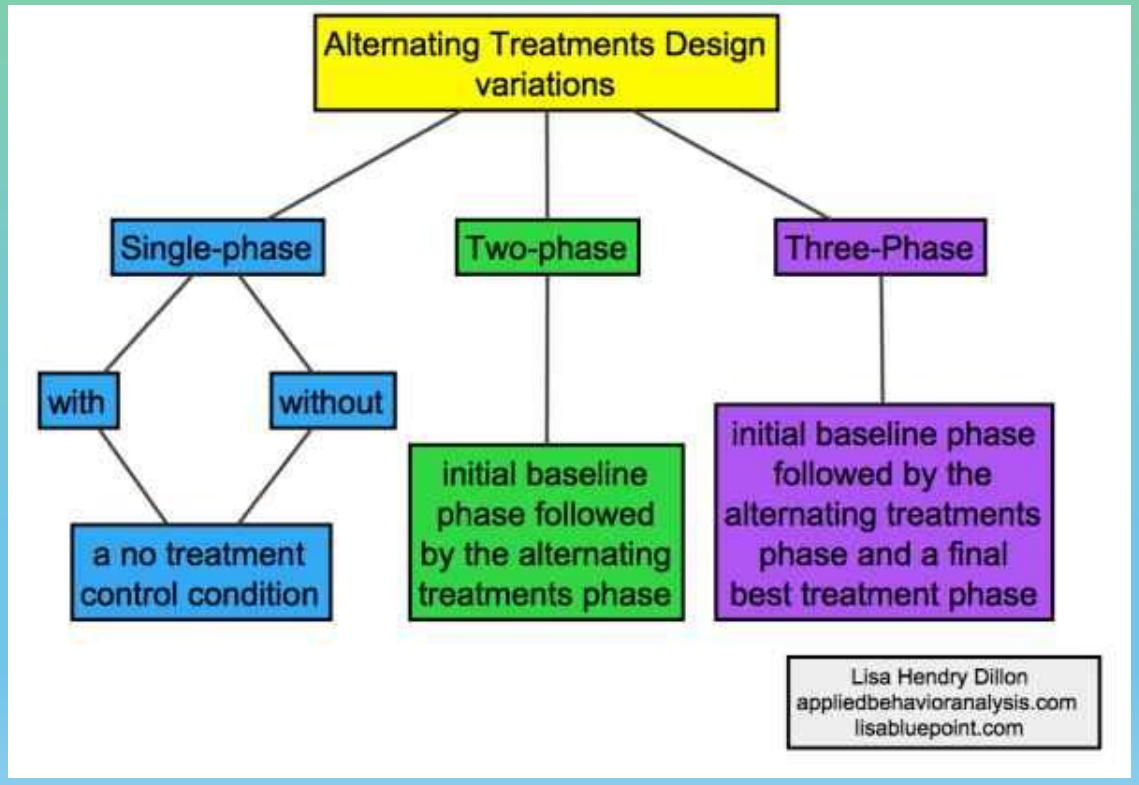

Alternating Treatment Design Example

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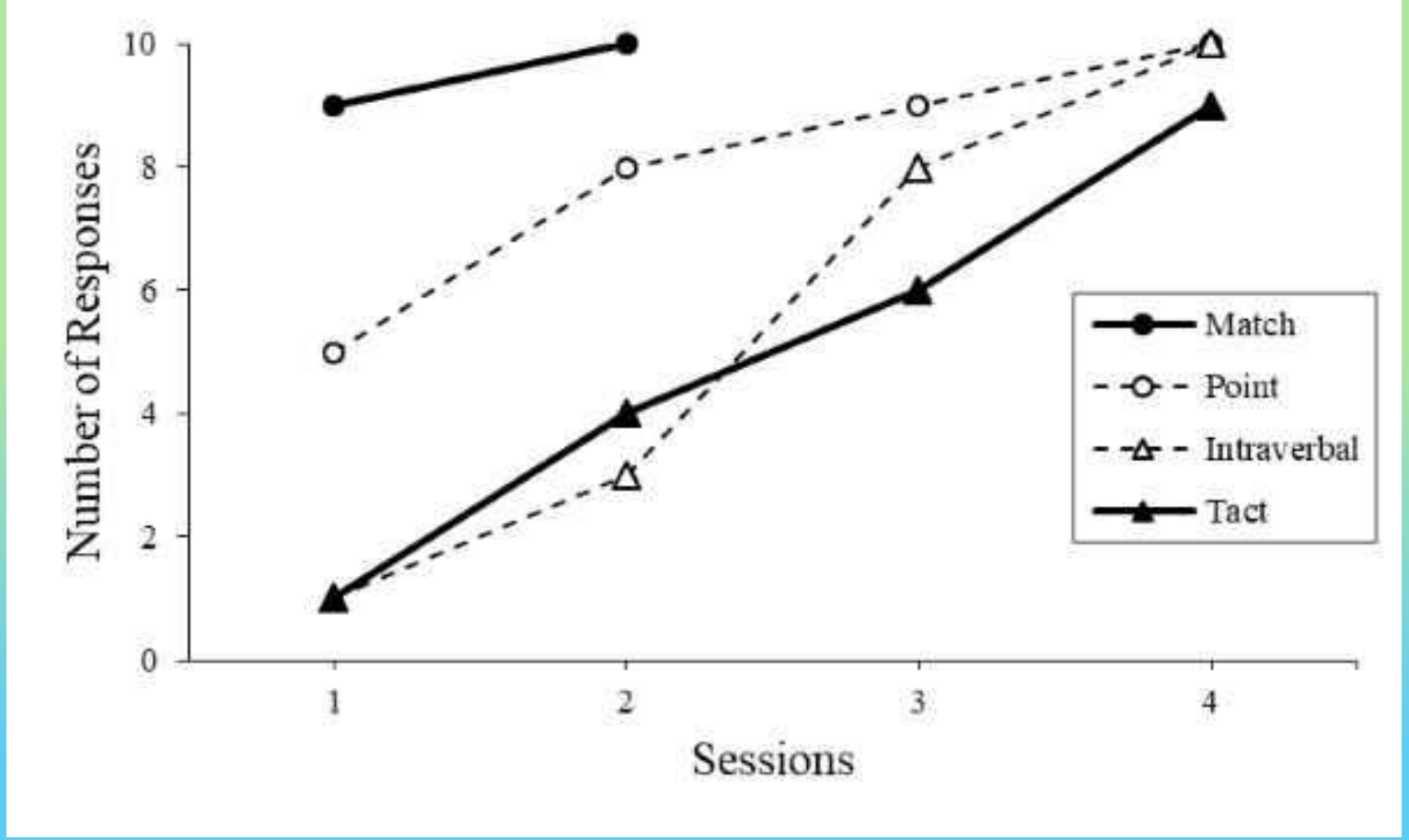


Methodology of Single-Subject Experimental Designs (SSEDs)

Key Features:

Individual participant as the unit of analysis

Repeated, systematic measurement over time

Design Types:

A-B Design

Reversal (A-B-A or A-B-A-B)

Changing Criterion

Multiple Baseline

Multiple Treatment Design

Alternating Treatments

Data Collection:

Visual and graphical representation of data

Continuous monitoring of dependent variables

Visual Analysis of Data

Key Components:

- Level: Baseline vs. intervention levels
- Trend: Direction of data points
- Variability: Consistency of data points
- Immediacy of effect: Change upon intervention
- Overlap: Degree of data point overlap

Tools:

- Line graphs
- Phase change lines

Advantages of SSED

- Tailored to individual needs
- Flexibility in implementation
- Requires fewer participants
- Provides clear, immediate feedback
- High internal validity

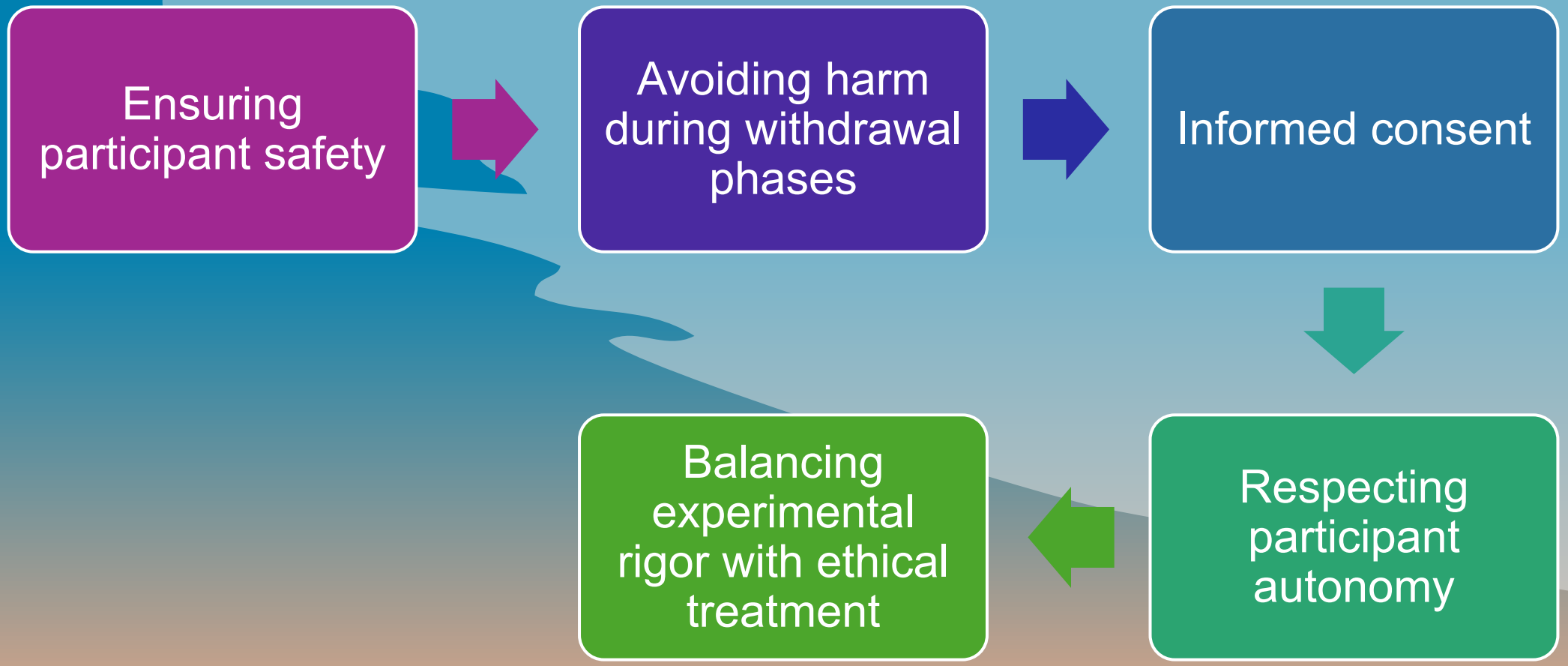
Limitations of SSED

- Limited generalizability to larger populations
- Potential ethical concerns with reversal designs
- Dependence on accurate, consistent data collection
- Requires expertise in visual analysis

Applications in Practice

- Behavioral interventions
- Skill acquisition programs
- Treatment for developmental disabilities
- Clinical decision-making
- Research to practice translation

Ethical Considerations



Future Directions

Expanding use in diverse populations

Integration with technology for data collection

Enhancing statistical methods

Promoting cross-disciplinary applications

Conclusion

01

SSEDS ARE A CORNERSTONE OF EVIDENCE-BASED PRACTICE

02

PROVIDE DETAILED INSIGHTS INTO INDIVIDUAL BEHAVIOR

03

BALANCING BENEFITS AND LIMITATIONS ENSURES EFFECTIVE APPLICATION

04

CONTINUED INNOVATION WILL STRENGTHEN THEIR ROLE IN RESEARCH AND PRACTICE

References

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