



Use of Hierarchical Exposure and Positive Reinforcement in Increasing Food Acceptance in Children with Autism Spectrum Disorders

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ASHA Disclosures

- ▶ Financial Disclosures
 - ▶ None
- ▶ Non-Financial Disclosures
 - ▶ None

What Makes Up a Feeding Disorder

- ▶ Medical
- ▶ Nutrition
- ▶ Behavior
- ▶ Feeding Skills
- ▶ Sensory
- ▶ Family Stress



Avoidant/Restrictive Food Intake Disorder

- ▶ A. Persistent failure to meet nutritional/ energy needs with 1 (or more) of the following
 - ▶ Weight loss, failure to maintain weight (fall off growth chart)
 - ▶ Nutritional deficiency (significant)
 - ▶ Depends on enteral feedings or oral supplements
 - ▶ **Marked interference with social functioning**
- ▶ DSM 5 (2013)

Criteria

- ▶ B. Not due to lack of food or cultural practice
- ▶ C. Does not occur with Anorexia Nervosa or Bulimia Nervosa (no body image issues)
- ▶ D. Not due to concurrent medical condition or mental health disorder
 - ▶ **Unless, severity of feeding concerns exceeds what is typically seen with that condition**
 - ▶ **Warrants additional clinical attention**

Behavioral Eating/Feeding Disturbance

- Lack of interest in food or eating
- Don't seem to care about what other people eat
- Don't show hunger
- Concerns about aversive consequences of eating
- It might make me sick, It tastes bad
- Avoidance based on sensory characteristics of food
- That looks gross, It's too sticky, It smells bad

Diagnostic Features

▶ Sensory Characteristics

▶ Smell, texture, taste, temperature, color, shape

▶ Brand and Container

- Food selectivity
- Food refusal
- Food neophobia
 - Anxiety



Food Selectivity in ASD

SALTY

BLAND

WHITE

DRY

CRUNCHY

BRAND

Feeding Problems in ASD

- ▶ Lots of research on feeding problems in children with ASD.
 - High-Probability demands (Gentry & Luiselli, 2008)
 - Escape Extinction (Freeman & Piazza, 1998)
 - Fading (Patel, et al, 2001)
 - Differential Reinforcement (Levin and Carr, 2001)
 - Simultaneous vs. Sequential Presentation (Piazza, et al, 2002)
 - Repeated Exposures
 - ▶ Seiverling, Williams, Ward-Horner, & Sturmey 2011

Feeding strategies

FADING	SHAPING
Fade a STIMULUS	Shape a RESPONSE
Change shape or brand of food Require same behavioral response	Leave food same shape or brand Alter responses needed
Try McDonald's and Wendy's French Fries Response – Bite and swallow	McDonald's French Fries Response – touch, lick, bite, swallow

Fading Liquids



▶ Patel et al (2001)

- ▶ Fade from water to milk to eliminate G-tube
- ▶ 3.75 ml fluid per offer
- ▶ CIB powder into water, CIB powder into milk
- ▶ Jaw prompting
- ▶ Fade 5% to start, increase increments of 10%
- ▶ At 30% strength, child switched to target liquid at 100% for both



SOS

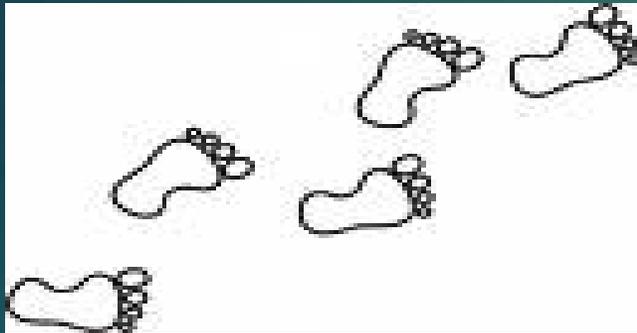


- ▶ Sequential Oral Sensory Approach
 - ▶ By Kay Toomey, PhD
- ▶ Looks at the “whole child” – organ systems, muscles, development, sensory, oral motor, learning, behavior and cognition, nutrition and environment
- ▶ Increase the child’s comfort level by exploring and learning about food in playful situations without stress

SOS, ct'd

- ▶ Individual and group therapy
 - ▶ Based on Albert Bandura's theory that children learn more from age appropriate peers who have the same behaviors
- ▶ Developmental progression – move as the child is willing/able
- ▶ Program has 32+ steps
- ▶ No experimental research
- ▶ Specific procedures only available from workshops.
- ▶ Copyrighted

Steps Toward Eating



- Bite and swallow
- Bite and chew
- Bite and hold
- Bite a piece off
- Hold food in teeth

- **Bite**

- Actively licks food – tongue sweeps over food
- Touch food to tongue
- Lick food off lips

- **Lick**

- **Kiss** – touch food to lips

- Actively smells food
- New smells in front of them
- New smells at table

- **Smell** food in room

- **Touch** foods – with fingers as appropriate

- Use utensils to cut and stab with knife and fork
- Use utensils to serve themselves and others
- Use utensils to stir or pour

- **Interact** with food preparation and/or table set up

- Tolerate the food on their plate
- Tolerate the food near them
- Tolerate the food on the table

- **Tolerate** food in the same room with new foods



Is It Effective?

- ▶ The SOS method, including The Steps to Eating are frequently used in outpatient therapy or in the schools with SLP and OT.
- ▶ Anecdotally, it is reportedly very effective
- ▶ They often don't have opportunity to do it systematically
- ▶ Need a way to empirically evaluate it

Tanner & Andreone (2015)

- ▶ “Using Graduated Exposures and Differential Reinforcement to Increase Food Repertoire in a Child with Autism”
- ▶ Case example of a 3.5 year old boy with ASD who ate 4 specific foods.
- ▶ All 4 foods tried at the same time
 - ▶ 5 pieces of each food per session
- ▶ Asked child to choose what he/she wanted
- ▶ Relaxation
- ▶ Token Economy and Visual Supports
- ▶ Parent training/generalization

12 Hierarchy

Steps

1. Tolerate food in therapy room

7. Lick food and throw away

2. Tolerate food on therapy table

8. Lick food 5 times and throw away

3. Tolerate food within 1 foot

9. Break food with teeth and throw away

4. Touch food and throw away

10. Chew food 5 times and throw away

5. Smell food and throw away

11. Eat a small piece

6. Kiss food and throw away

12. Eat an entire piece

Results

- ▶ 100 sessions over 9 months, gained 50+ foods
- ▶ Number of sessions needed decreased over the course of the study
- ▶ This took a very long time
- ▶ No experimental control
 - ▶ Data collected via ABC and frequency counts
- ▶ Did not do official probes to determine where to go next
- ▶ Parents were engaged in generalization
 - ▶ 27 foods

Koegel, et al, 2011

- ▶ Individualized Reinforcers and Hierarchical Exposure to Increase Food Flexibility
- ▶ Longitudinal data (22 weeks) across 48 foods for 3 children.
- ▶ MBL across participants for 5 foods
- ▶ Generated a hierarchy of behaviors the child needed to exhibit to earn reinforcement

Hierarchical Levels of Acceptance

- ▶ 0 = Refuses to try food (w or w/out disruptive behavior)
- ▶ 1 = Touches food and motions towards mouth
- ▶ 2 = Puts the food to lips
- ▶ 3 = Bites the food
- ▶ 4 = Bites and puts in mouth, refuses to swallow
- ▶ 5 = Chews the food but refuses to swallow
- ▶ 6 = Swallows the food “reluctantly”
- ▶ 7 = Accepts without any signs of displeasure or disruptive behavior

Koegel et al 2011 Results

- ▶ DV's – number of foods accepted, spontaneous requests for new foods, verbal responses, and level of acceptance (hierarchy)
- ▶ Accepted 6, 15, 16 foods respectively at follow up
- ▶ Participant with the fewest foods went through a series of levels before acceptance.
- ▶ Others showed almost immediate acceptance at level 7

Shaping

- ▶ SOS, Hierarchies
- ▶ Want to try a strategy that could be done more efficiently in a school setting
- ▶ For lower intensity food refusal and selectivity
- ▶ For behaviors that cannot be easily obtained just by teaching, exposure, or basic prompts
- ▶ If systematic and use consistent SR+, could get better outcomes

Keys to Shaping

Differential Reinforcement



Successive Approximations

Positive Reinforcement

- ▶ Positive Reinforcement (SR+)
 - ▶ A behavior that is followed by a positive consequence, is more likely to occur again in the future
 - ▶ Behaviors that do not result in positive consequences, are less likely to occur (Extinction)
- ▶ For shaping, specific behaviors will be reinforced and all others will be on extinction.
- ▶ The behaviors to be reinforced will change as the previous ones are acquired.

Successive Approximations(SA)

- Start by reinforcing a response in the child's current repertoire, that shares characteristics or are a prerequisite for the terminal behavior
- Change criterion to next closest behavior in the class and provide reinforcement for that behavior
- Used to teach complex behaviors (tooth brushing), improve tolerance to nonpreferred stimuli, increase duration of time engaged in activities



Shaping

“Touch-Smell-Kiss-Lick-Bite”

- Hierarchy
 - Touch
 - Smell
 - Kiss
 - Hold in teeth
 - Lick
 - Bite
 - Bite and expel
 - Bite hold and expel
 - Chew and expel
 - Chew and swallow



Benefits of Shaping

- Steps should always move towards terminal goal



- Focus on Reinforcement
- Punishment & other aversive are not used
- Can combine it with other procedures (chaining)

Limitations of Shaping

- Time consuming
- Progress not always linear
 - ▶ May need to add in new steps, change current steps
 - ▶ Go backwards
- Have to monitor progress closely
 - ▶ Staying too long at a particular step may cause the child to get stuck .
 - ▶ Makes it harder to get to the next step
- Inadvertently SR+ and strengthen inappropriate behavior



How to Develop a Shaping Program

1. Select a Terminal Goal

- Pick the behavior you want the child to do independently at the end of the program
- Make sure it is one child is capable of learning

2. Define criteria for success

- 80-100% compliance before moving ahead
- Over 3 consecutive trials



3. Analyze the Response Class

- ▶ Response Class - Responses function to earn the same reinforcer
- ▶ Shape across Topographies
 - ▶ Reinforce certain members of a response class and not responses outside the response class.

Response Class, ct'd

- Choose behaviors in the response class
 - ▶ Pick behaviors already in the child's repertoire
 - ▶ Clear operational definitions
 - ▶ What approximations will get reinforcement
- Sometimes the behaviors may be “approximations” or guesstimates

4. Identify First Behavior

- ▶ Choose a behavior they already do at some level
- ▶ What will be the easiest behavior for the child to emit initially?

5. Gradual Steps

- ▶ Choose your steps sequentially
- ▶ Build off each other
- ▶ Need each to complete terminal goal
- ▶ Each step should be more challenging, but attainable.
 - ▶ Gets them used to the process that the requirement will change but reinforcement remains



Limit Time at Each Step



- Limit # of approx. at each level
- ▶ Need to know when to move forward or back
- ▶ Slows down progress by doing too many trials at one step
- ▶ May make behavior firmly established, difficult to extinguish
- ▶ If they make too many mistakes or don't exhibit the behavior, criteria may have been raised too high

Improve Efficiency

- ▶ Developmental programs wait for the child to initiate the next approximation
- ▶ Use prompts as discriminative stimulus to respond
 - ▶ Verbal
 - ▶ Model
 - ▶ Physical



Using Reinforcement

- ▶ Identify current/immediate reinforcers
- ▶ Use contingently for compliance
- ▶ Maintenance and Generalization



Additional things

- ▶ Eliminate distractions
- ▶ ID target foods
 - ▶ Used to eat foods
 - ▶ Similar foods
 - ▶ New foods



Pryor's 10 Laws of Shaping

Small steps so child has good chance of contacting reinforcement	One trainer per behavior
Train one behavior at a time	Can add as many steps in as needed
Once a behavior is acquired, put it on VR schedule before moving to next step	Don't interrupt a session
At next step, relax requirements for previous one	Go back to kindergarten
Plan program ahead of time to you can make adjustments as needed.	End on a good note - Quit while you are ahead.

Our Study - Setting

- ▶ Stepping Stones Learning Center
 - ▶ Conducted all sessions
- ▶ University of Rochester Medical Center
 - ▶ IRB
 - ▶ Data analysis
 - ▶ Consultation

Research Population

- ▶ Number of Participants
 - ▶ 3-6 participants targeted
 - ▶ 4 total: 1 Pilot, 3 Study



Research Population

- ▶ Gender of Participants
 - ▶ 3 male, 1 female



Research Population

- ▶ Age of Participants
 - ▶ Males: 4, 5
 - ▶ Female: 5



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Research Population

- ▶ Racial and Ethnic Origins
 - ▶ No enrollment restrictions based on race or ethnic origins
 - ▶ (1) Eastern Indian, (2) Caucasian, (1) Asian



Research Population

▶ Inclusion Criteria

- ▶ Age 2-6 years old
- ▶ Confirmed diagnosis of ASD
- ▶ Self-Limited, restricted diet as reported by parent/caregiver



Research Population

▶ Exclusion Criteria

- ▶ Prior feeding therapy using same model
- ▶ Active medical/oral motor issues, including but not limited to: problems with chewing and swallowing, aspiration, and reflux
- ▶ Medications that directly or indirectly suppress or stimulate the appetite



Methods and Procedures

- ▶ Research Design
 - ▶ Changing criterion design to assess shaping techniques for changing behaviors (increased food acceptance)



Methods and Procedures

▶ Research Design

▶ **Multiple Probe** will be used to evaluate the potential carryover effects of intervention on “Food #1” to “Food #2”, and as a result of said effects establishing a new baseline.

▶ Useful in evaluating the effect of instruction on skill sequences when it is unlikely that the subject will master the later steps without instruction.

Methods and Procedures

▶ Research Design

- ▶ Continuous data collection during baseline (no treatment) condition, followed by intervention condition, until participant meets a pre-determined criterion for progress.
- ▶ Last accomplished phase becomes the baseline and new criterion is set.
- ▶ Repeated until final criterion is met.

Methods and Procedures

- ▶ Changing criterion – used to evaluate the effects of a treatment on the gradual or stepwise improvement of a behavior already in the child's repertoire

Methods and Procedures

- ▶ Steps in the study were behaviors that the child could demonstrate in getting closer to the terminal response of eating.
 - ▶ For example: Touch, Smell, Kiss, Lick
 - ▶ Each step gets the child closer to the terminal goal of Accepting and Swallowing a food, but each step is not required to complete the terminal physical goal of eating.
- ▶ Shaping vs Chaining – **Shaping** involves using each step as a successive approximation that will bring us closer to the end goal.
Chaining involves putting together the actual steps that the end goal requires for completion.

Methods and Procedures

▶ Treatment Procedure

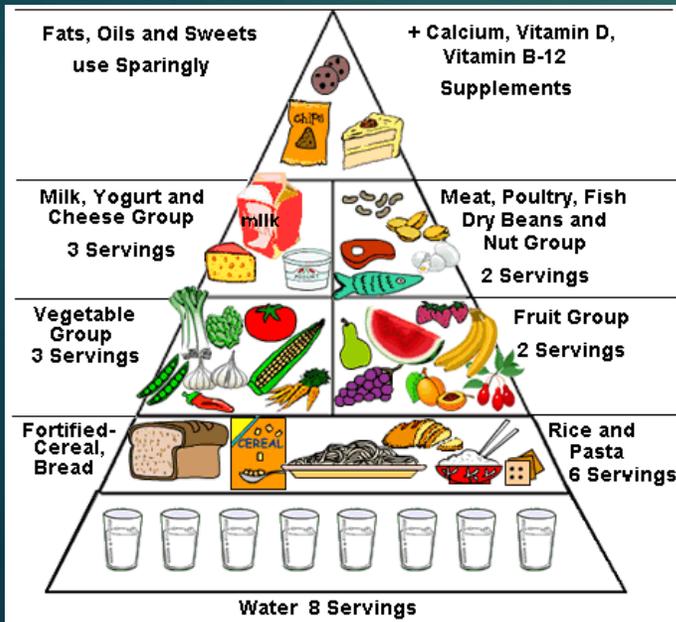
- ▶ Parents/caregivers complete a checklist to select foods they would like their child to eat.
- ▶ Foods also chosen based on foods the child already gets.



Methods and Procedures

▶ Treatment Procedure

- ▶ During baseline and intervention probes, feeding team will present the participant with foods selected from the list provided by parents/caregiver



Methods and Procedures

- ▶ Treatment Procedure
 - ▶ Intervention involves **Hierarchical Exposure** – desensitizing the participant to a novel food by starting with low levels of contact with the food and then gradually and systematically increasing the level of exposure.



Methods and Procedures

▶ Treatment Procedure

- ▶ A baseline probe will be administered with each new food introduced in order to assess where in the treatment hierarchy to begin.



Methods and Procedures

- ▶ Treatment Procedures: **PROBE PROCEDURE**
 - ▶ **Initial Probes**: During the initial session with each new food the researcher will offer one food across each set of hierarchical steps from “touch” to “swallow” in order to obtain a baseline.



Methods and Procedures

- ▶ Treatments Procedures: **PROBE PROCEDURE**
 - ▶ Each step will be presented 5 times in a row and compliance will be recorded.
 - ▶ If the participant does not respond within 10 seconds the researcher will move to the next instruction.
 - ▶ The researcher will continue through the entire process regardless of the participant responses (correct or not at all)

Methods and Procedures

- ▶ Treatment Procedures: **PROBE PROCEDURE**
 - ▶ Additional Points
 - ▶ We may explain the steps to the participant prior to beginning. (Ex: We are going to kiss the cracker 5 times)
 - ▶ Visuals are acceptable tools to augment the participant's understanding of the process.



Methods and Procedures

- ▶ Treatment Procedures: **PROBE PROCEDURE**
 - ▶ Additional Points
 - ▶ At this baseline no prompting or reinforcement will be given
 - ▶ Treatment will begin either
 - ▶ No Criterion was met
 - ▶ Following the last step completed at 80% or better



Methods and Procedures

- ▶ Treatment Procedures: **PROBE PROCEDURE**
 - ▶ Subsequent Probes
 - ▶ Once 80% has been achieved during the **TREATMENT** phase, doing each step 5 times, across three trials, another probe session will be conducted to determine what the next baseline will be.
 - ▶ Probes occur after each step has been successfully completed, as it is anticipated that after completing a few of the steps, some participants may be able to skip steps and create a new baseline further along the hierarchy.

Methods and Procedures

▶ Treatment Procedure

- ▶ Begins after treatment probe has been completed and the starting level of exposure has been determined.
- ▶ Begins with the first step the child was unable to successfully complete during the probe.



Methods and Procedures

▶ Treatment Procedures

- ▶ A verbal instruction will signal the start of the intervention session
- ▶ Social reinforcement will be used, except during a probe, to motivate the child and to strengthen cooperation with the task



Hierarchical Steps 1-5

Level of Acceptance	Description
1 - Touch	Food will be placed in front of the participant. The participant will be instructed to "Touch (food)". The participant touches food with a finger
2 - Smell	Participant is instructed to "Smell (food)". The participant smells food from a distance of no greater than 6 inches
3 - Kiss	Participant is instructed to "Kiss (food)". The participant touches food to lips. Puckering of the lips is not necessary.
4 - Lick	Participant is instructed to "Lick (food)". The participant touches tongue to food.
5 - Hold in teeth	Participant is instructed to "Hold (food) in your teeth". The researcher will then count to 5 aloud. The participant must hold a solid food between his/her teeth for 5 seconds, and then may expel it onto a plate or napkin.

Level of Acceptance	Description
6 – Bite and Expel	Participant is instructed to “Take a bite of (food)”. An accepted bite must be bigger than a cheerio or pea. The participant does not necessarily have to place his/her teeth into the food, but must at least place the food in his/her mouth for the entire 5 seconds. They may then expel the food.
7 – Bite and Hold	Participant is instructed to “Take a bite of (food) and hold it”. The researcher will then count to 5 aloud. The participant must hold the food in his/her mouth for the entire 5 seconds, and then may expel it.
8 – Chew and Expel	Participant is instructed to “Take a bite of (food) and chew it”. The participant must complete a minimum of 5 chews and then may expel it.
9 – Accepts and Swallows	Participant is instructed to “Eat the (food)”. The participant must take a bite of the food (greater in size than a cheerio or pea), chew the food and swallow it.

Hierarchical Steps 6-9

Methods and Procedures

▶ Treatment Procedures

- ▶ If the participant complies with the instruction given, verbal praise is offered and the participant will be given another trial.



Methods and Procedures

▶ Treatment Procedures

- ▶ If the participant does not comply with the initial instruction, a demonstration model prompt may be given and the instruction repeated.
- ▶ If the participant still does not comply with the instruction, a physical prompt may be offered and the instruction repeated.

Methods and Procedures

▶ Treatment Procedures

- ▶ Each level of acceptance must be done in 3 sets of 5 trials
- ▶ A break may be given between sets
- ▶ Criteria for moving onto the of acceptance is 12/15 (80%) successful trials



Methods and Procedures

▶ Treatment Procedures

- ▶ Water will be made available for sipping throughout all work with food.
- ▶ Visuals may be used to augment the child's understanding of instructions.
- ▶ Corrective feedback will not be given.



Participants

- ▶ Participant #1: **Jack**
 - ▶ Ethnicity: Eastern Indian
 - ▶ Age: 4 years old
 - ▶ Verbal Ability: Non-verbal, low receptive ability
 - ▶ ABA for 2.0 years

Intervention

Jack

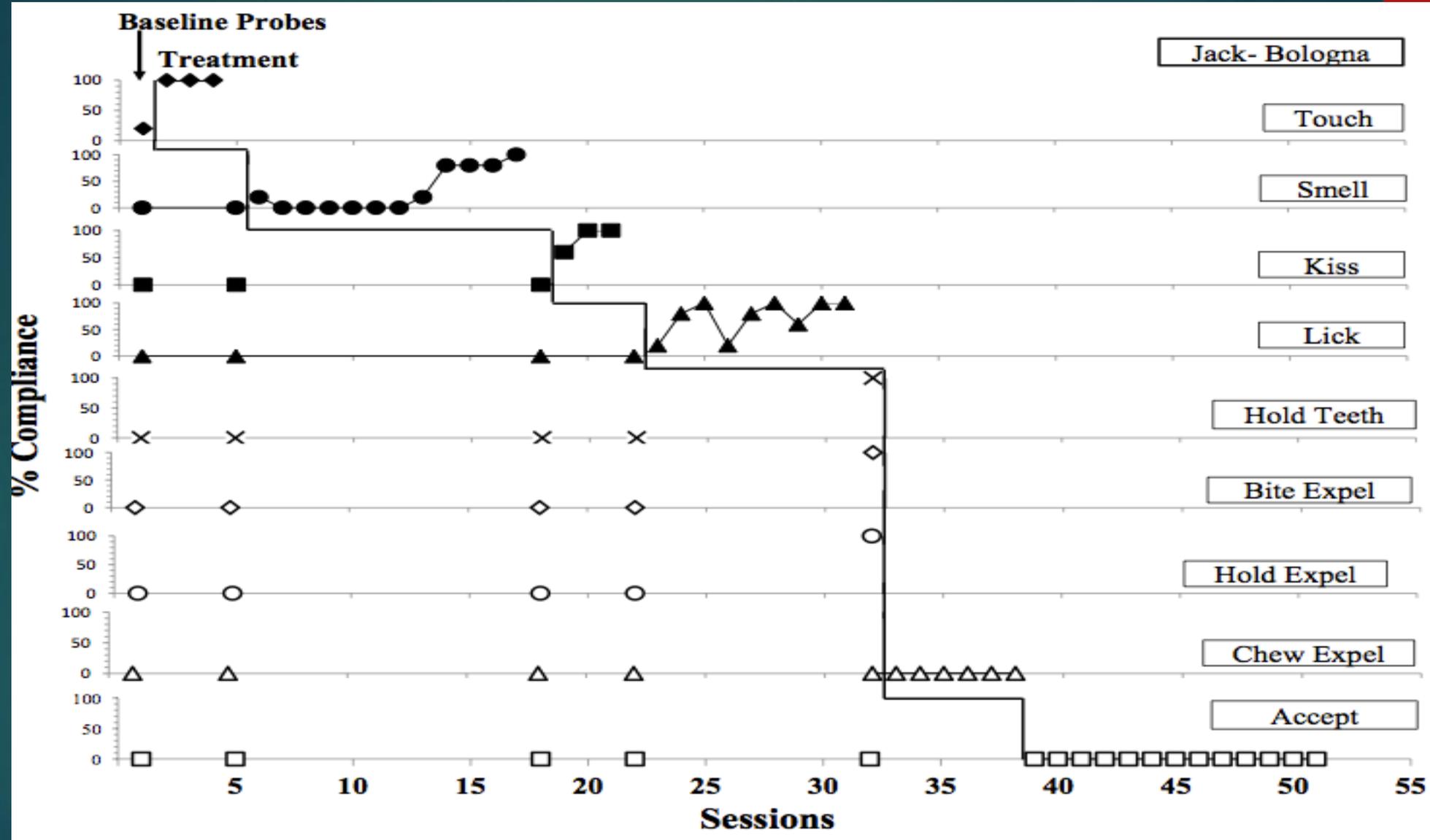
- ▶ Parents completed the **Food Preference Checklist**
 - ▶ Ate mostly starches (bread, crackers, mac and cheese...)
 - ▶ Ate most fruit
 - ▶ Did not eat any vegetables or protein

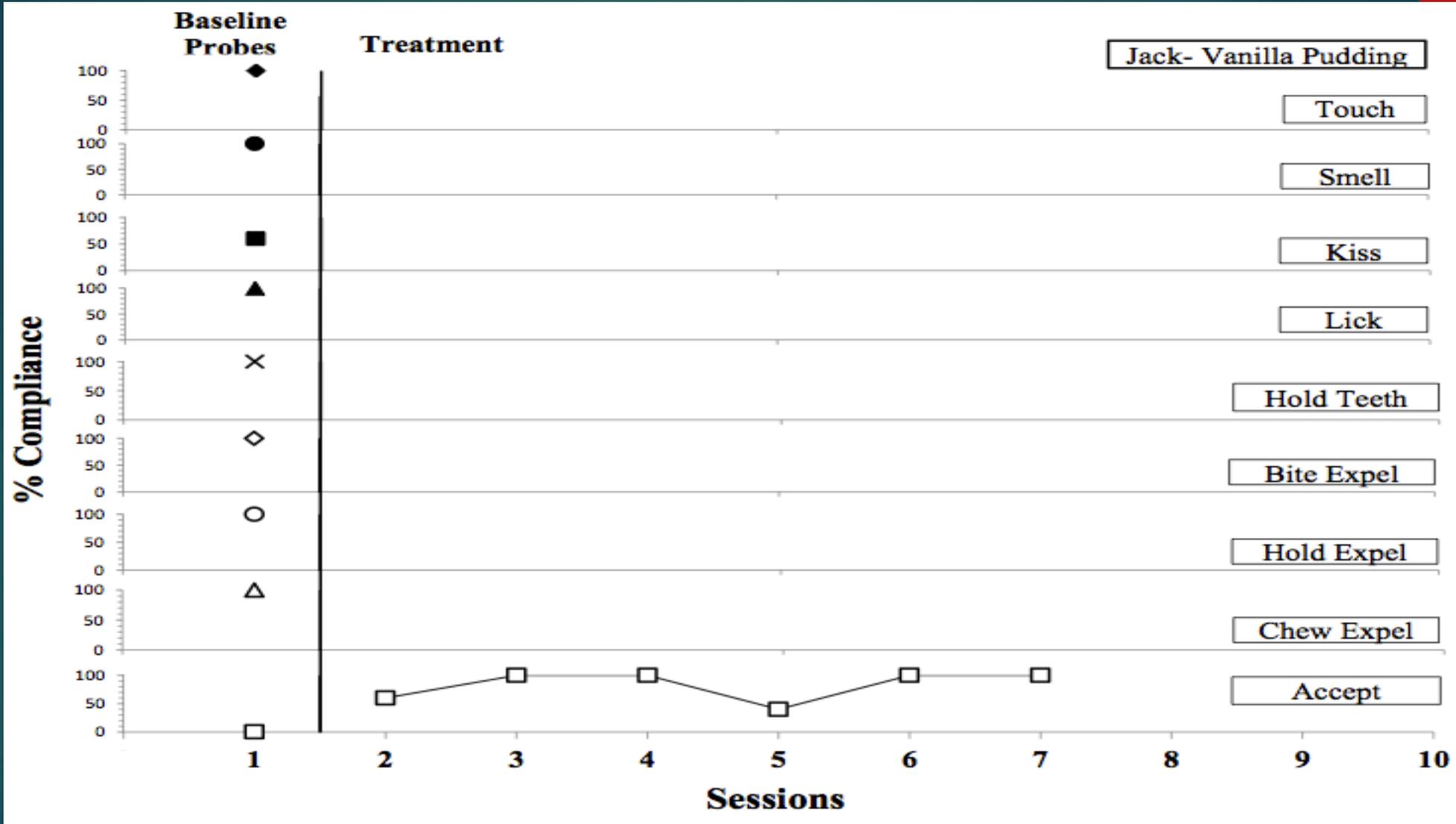


Intervention

Jack

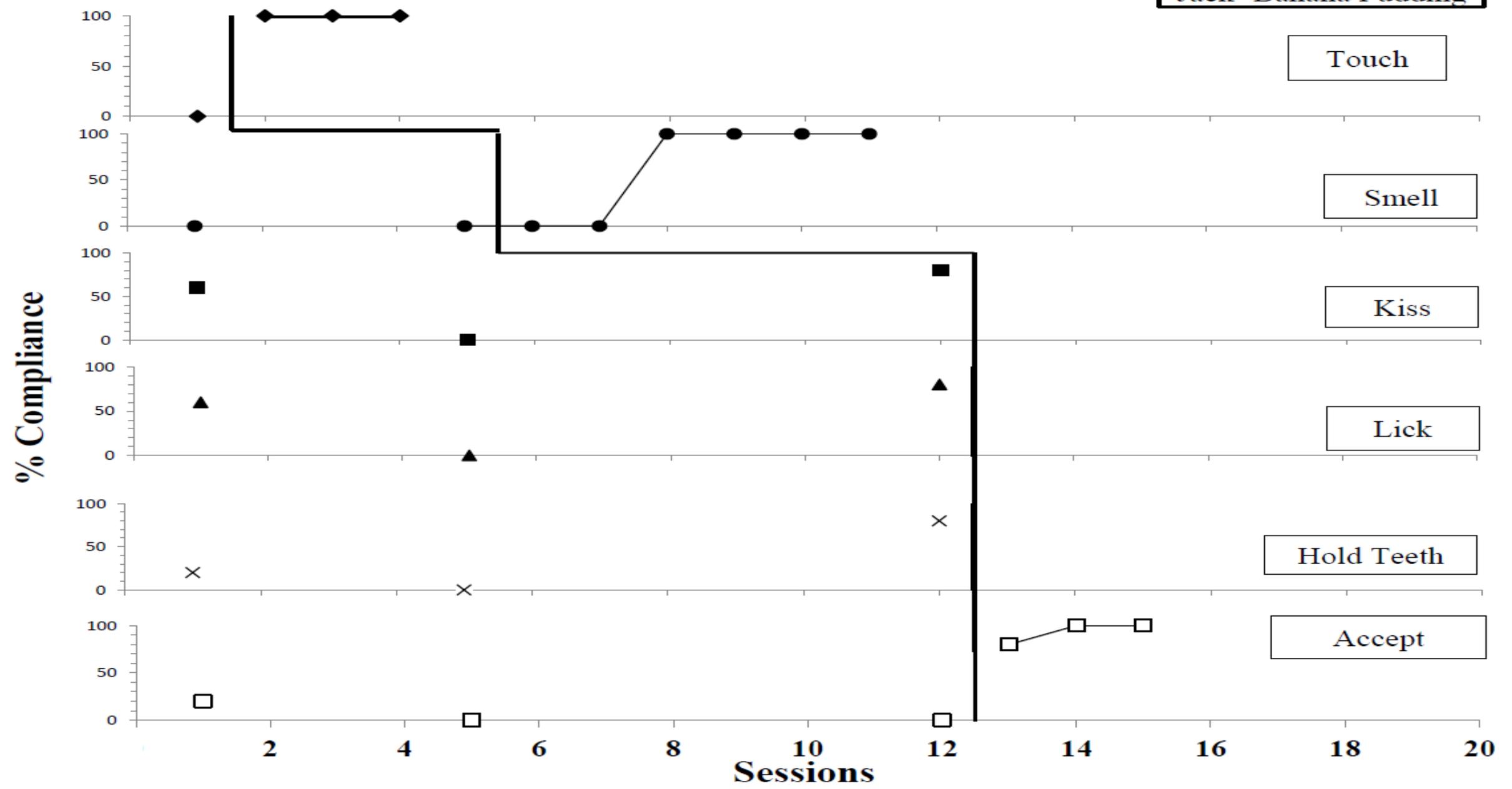
- ▶ Based on the Food Preference Checklist of foods Jack *currently eats*, he *used to eat*, and the foods his parents *would like him to eat* the following foods were selected to target:
 - 1) Bologna
 - 2) Pudding
 - 3) Dry Cereal





Baseline
Probes **Treatment**

Jack- Banana Pudding



Participants

- ▶ Participant #2: **Jena**
 - ▶ Ethnicity: Caucasian
 - ▶ Age: 5
 - ▶ Verbal Ability: minimally verbal
 - ▶ SCERTS program for 2 years
 - ▶ Attendance issues

Intervention

Jena

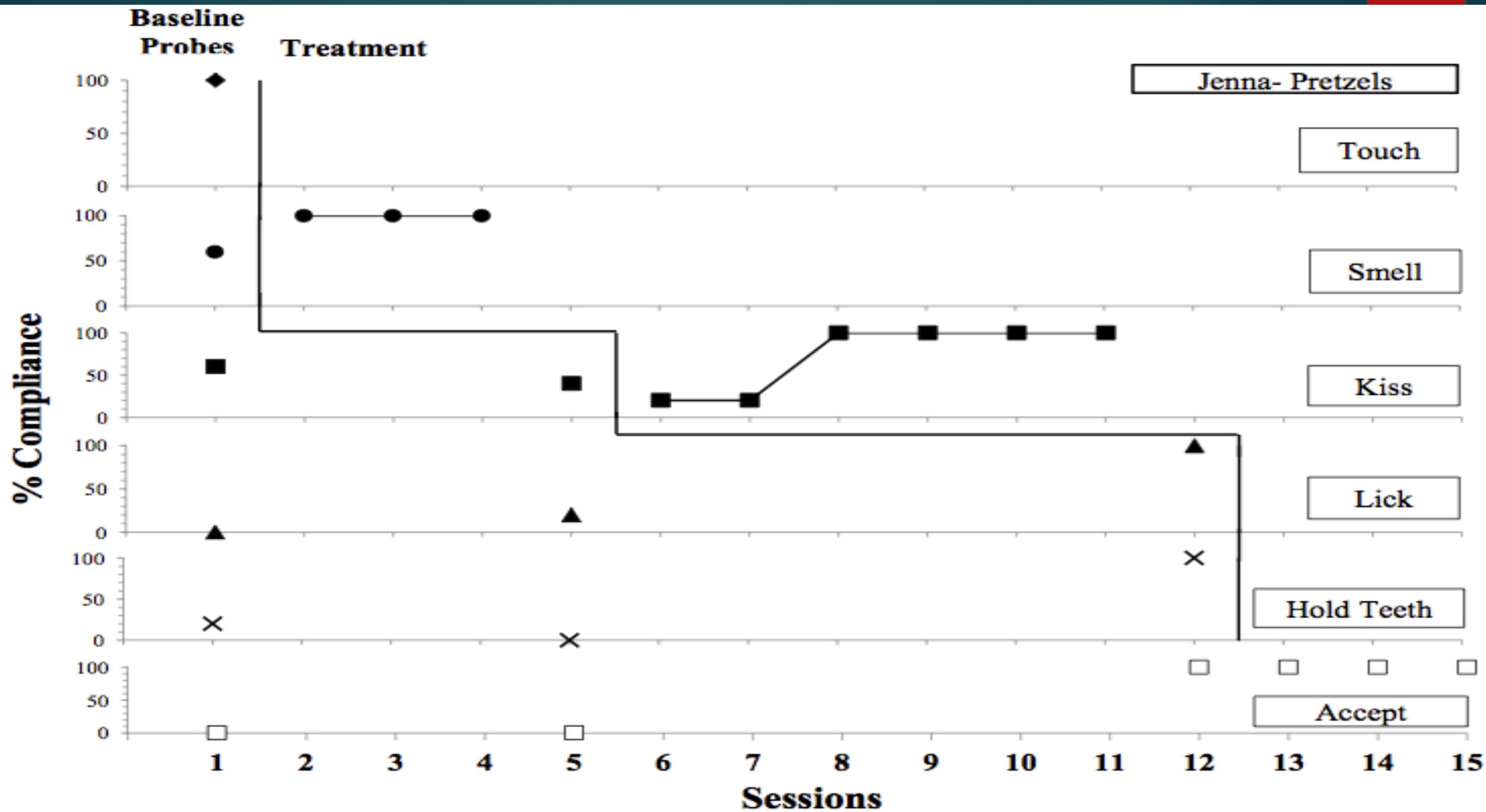
- ▶ Parent completed ***The Food Preference Checklist***
 - ▶ Mostly ate starches and fruits
 - ▶ No vegetables
 - ▶ No protein except peanut butter

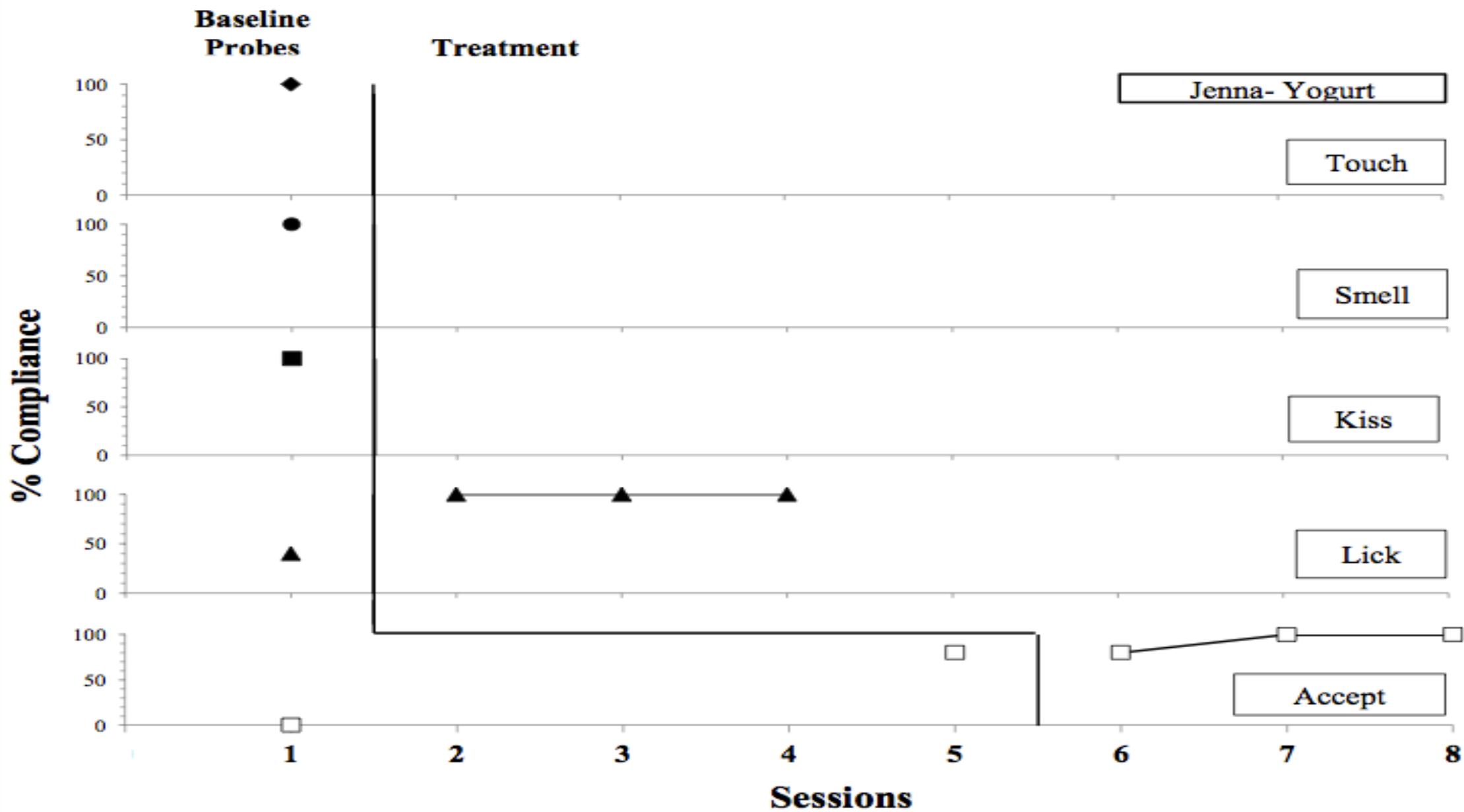


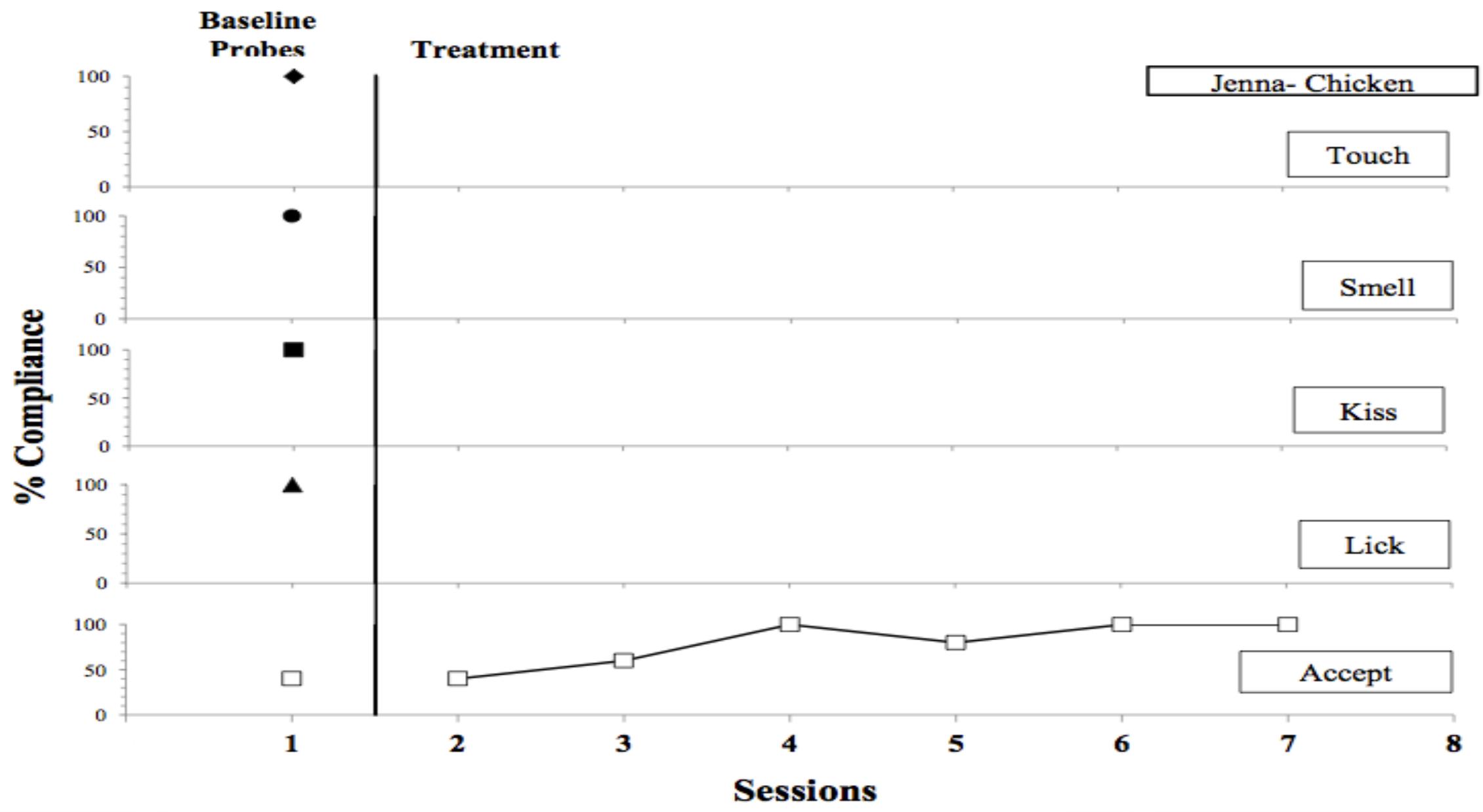
Intervention

Jena

- ▶ Based on the Food Preference Checklist of foods Jena *currently eats, she used to eat*, and the foods her mom *would like her to eat* the following foods were selected to target:
 - 1) Pretzels
 - 2) Yogurt
 - 3) Chicken







Participants

- ▶ Participant #3: **Brian**
 - ▶ Ethnicity: Caucasian
 - ▶ Age: 5
 - ▶ Verbal Ability: highly verbal
 - ▶ ABA program for 2+ years

Intervention

Brian

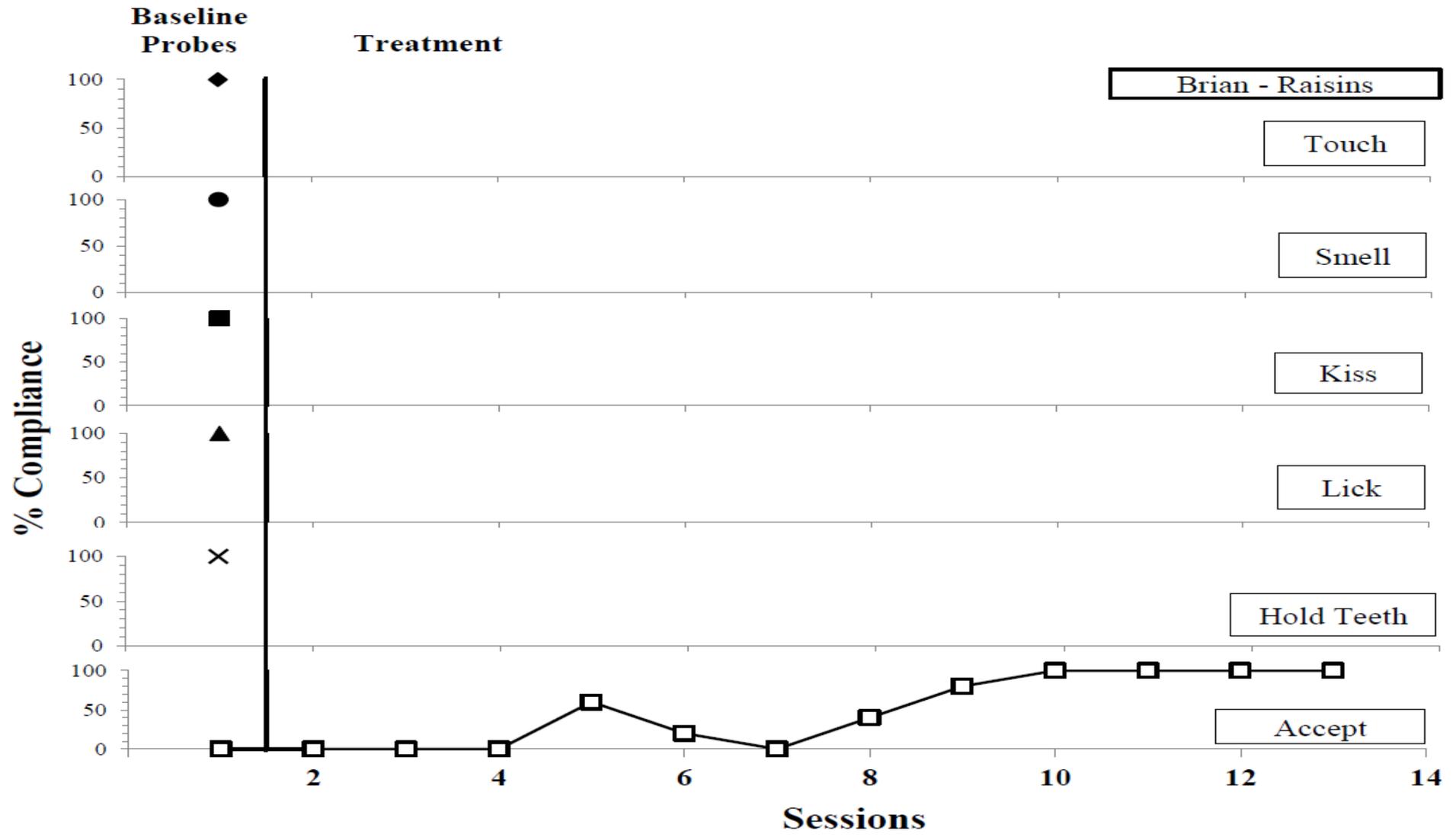
- ▶ Parent completed ***The Food Preference Checklist***
 - ▶ Mostly ate starches and some fruits
 - ▶ No vegetables
 - ▶ No protein except pepperoni occasionally

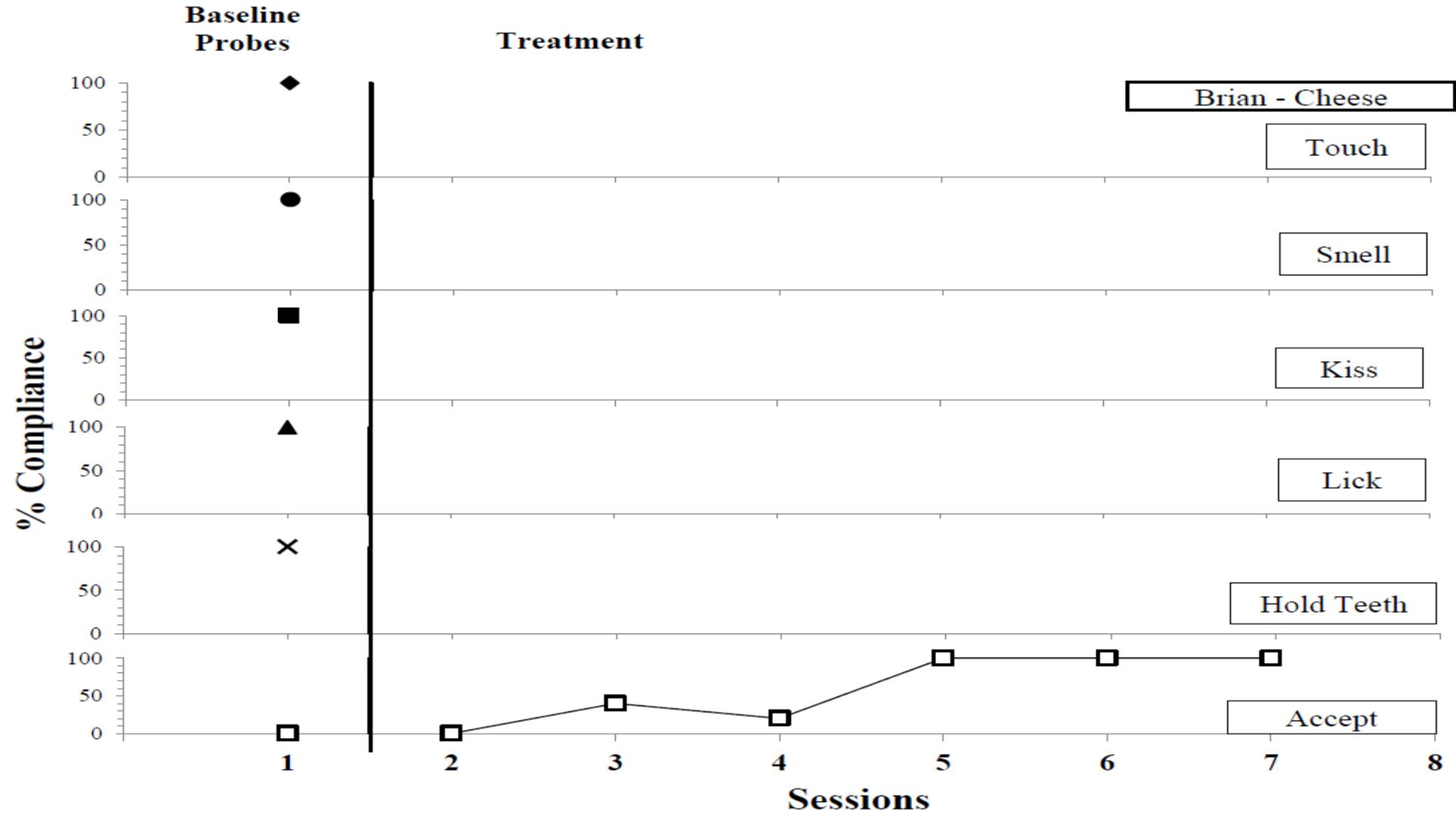


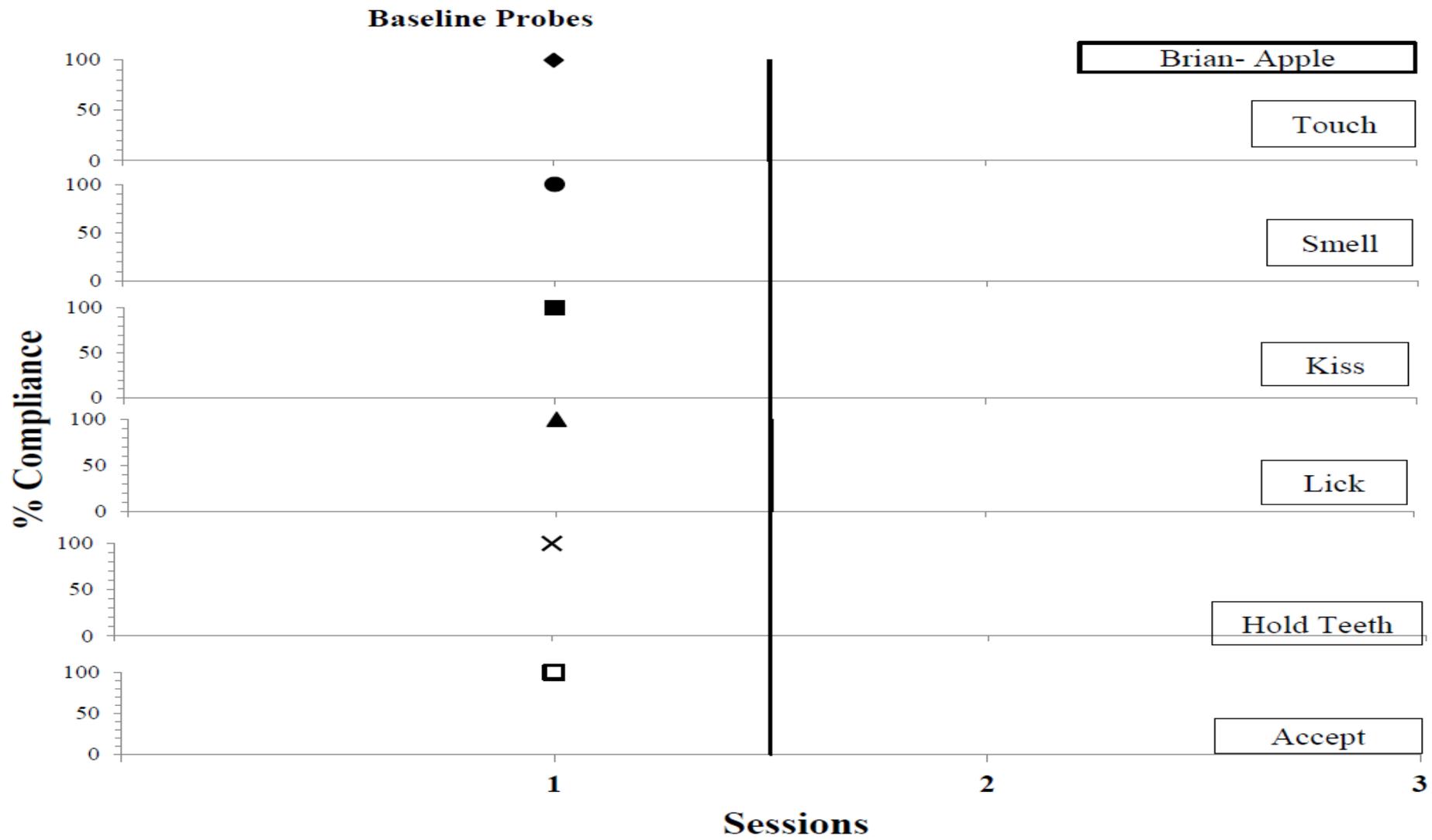
Intervention

Brian

- ▶ Based on the Food Preference Checklist of foods Brian *currently eats*, he *used to eat*, and the foods his parents *would like him to eat* the following foods were selected to target:
 - 1) Raisin
 - 2) Cheese stick
 - 3) Apple







Discussion



- ▶ Shaping is a viable treatment intervention for children with food selectivity and food refusal
- ▶ Multiple Probe design enabled you to make evidence based decisions to move children through the hierarchy
- ▶ Shaping allows you to start with a step that it is likely the child can comply with.
- ▶ As you gain compliance they become more likely to move forward towards the goal of eating

Summary Table

Child	# of foods gained	Average # of probes	Average Tx sessions	Total # of steps skipped
Jack	3/4	3	20* (for bologna) 9	Bologna – 3 Vanilla Pudding – 7 Banana Pudding - 3
Jena	3/3	2	6	Pretzels – 3 Yogurt - 3 Chicken - 4
Brian	3/3	1	5	Apple – 6 (all) Raisins – 5 Cheese - 5

Summary Totals

Child	Foods	# of Probes Per food	# of Tx Sessions per food	Total # of steps skipped
Jack	Bologna	6	42	3
	Van Pudding	1	6	7
	Cereal	1	0	8
	Banana Pudding	3	12	3
Jena	Pretzel	1	12	4
	Yogurt	2	6	3
	Chicken	1	6	4
Brian	Apple	1	0	6
	Raisin	1	12	5
	Cheese	1	6	5

Benefits of Shaping

- ▶ Able to use in a school setting
- ▶ Without escape extinction
- ▶ Identifying food preferences
- ▶ Reinforcement
 - ▶ Children enjoyed social praise
 - ▶ Escape was allowed and did not interfere



Limitations

- Did not obtain Interobserver Agreement
 - ▶ Train more therapists, Video tape sessions
- Didn't collect any data on disruptive mealtime behaviors
- Didn't address parent training
 - ▶ Parent training offered, but declined
 - ▶ Grant – Treatment of Feeding Problems in Children with Autism Spectrum Disorders
 - ▶ Manualized training programs for parents
 - ▶ Shaping is one of the sessions

Goals for Independence

- ▶ Compliance
 - ▶ Reducing the demand
 - ▶ Reinforcement
- ▶ Tasting and Trying
 - ▶ Shaping
- ▶ Volume
 - ▶ Maintenance
- ▶ Mealtimes
 - ▶ Generalization



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