TACTING ACQUISITION WITH DIFFERENT INSTRUCTIONAL TEACHING METHODS

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ABSTRACT

Tacting is a critical skill that all children are expected to be able to do. The verbal behavioral definition of a tact is a label of something you see, hear, smell, taste, or touch. The antecedent for a tact is some form of stimulus and the consequence for a tact is indirect reinforcement, such as praise (Barbera & Rasmussen, 2007). The ability to tact allows a child to increase their communication and social skills, allowing them to answer questions from adults and label items in their environment. Tacting will also allow a child to increase their vocabulary, while also allowing them to be able to express themselves better. A child can tell us about covert feelings they are having (e.g., being hungry, tired, in pain). Children with autism spectrum disorder often have difficulty tacting because social reinforcement (e.g., praise, smiling) may be ineffective (Bak et. al., 2021). Due to the potential for a child's ability to tact to impact their social relationships and communication skills, it is crucial for behavior technicians, who often provide services to children with autism spectrum disorder, to effectively teach this skill. This study will analyze and compare different instructional teaching methods in the effectiveness of teaching tacts to children with autism spectrum disorder. Teaching interventions will consider how the setting may affect mastery progress (discrete trial training vs naturalistic environment training) while also looking at the different teaching methods used in each of these settings. Hypothesis for this study is that interventions taught in a naturalistic developmental behavioral intervention (NDBI) setting will aid children with ASD in meeting mastery criteria for tacting more quickly, as opposed to a discrete trial setting.

Keywords: tacting, autism spectrum disorder, discrete trial training, naturalistic environment training.

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Introduction

Tacting is one of the most critical verbal skills a young child learns (Dueñas et al., 2019). The verbal behavioral definition of a tact is a label of something you see, hear, smell, taste, or touch. The antecedent for a tact is some form of stimulus and the consequence for a tact is indirect reinforcement, such as praise (Barbera & Rasmussen, 2007). In short, tacting refers to the labeling of objects, activities, events, or properties of those stimuli (Dueñas et al., 2019). Tacting can include verbal and non-verbal observations of stimulus by one of the senses and is reinforced by social interaction from other individuals. Tacting usually beings in neurotypical children as early as late infancy, as they begin to label items in their environment (Hardy, 2020). An example of tacting can include a child passing by a field of cows and them saying "There's a cow!". Her father then might say, "Yes, those are cows". The father's response in this situation would be an example of reinforcement because the father observed the child's action and provided generalized conditioned reinforcement.

Children typically will tact in play situations with peers or adults (LaLonde et. al., 2020). Tacting provides children with an understanding of their environment and allows them to share information with others (LaLonde et al., 2020). By labeling items in the environment, the child therefore learns about different items. There are many situations in which a child tacts as this is a skill that likely occurs every day. The natural maintaining consequences that reinforce a child tacting will always be verbal, in that reinforcement is socially mediated (Dueñas et al., 2019). However, children with autism spectrum disorder (ASD) often experience delayed language skills, such as tacting, compared to their neurotypical peers (Dueñas et al., 2019). Children with ASD also show a greater delay in social-communicative skills, which includes tacting (LaLonde

et al., 2020). Therefore, tact acquisition may be a harder skill for children with ASD to learn, especially in a play setting or other natural social situations.

To teach tacting the child needs to attend to a specific stimulus in the environment, which may prove difficult for children with ASD (LaLonde et al., 2020). The reinforcers that maintain tacting may also be ineffective for children with ASD as they include things like social praise, which some ASD individuals may find not reinforcing. Therefore, to teach tacting to children with ASD explicit tact training is used. This training usually takes the form as a discrete trial or natural environment training (Dueñas et al., 2019).

Behavioral interventions have been shown to improve tacting in children with ASD. In research conducted by Dueñas et al. (2019) participants showed upward trending response rates for tacting when the intervention was implemented, compared to baseline sessions where each participant showed a 0% response rate for tacting. This study examined the effects of play-based interventions and how it affected response rates to tacting. Behavioral interventions generally involve teaching a set of targeted tacts to the child whether it be from an NET setting, like the previously mentioned study, or a DTT setting which involves the child learning tacting in a more structured setting, such as at a table.

Discrete Trial Training Interventions

Discrete trial training (DTT) is a structured technique that allows behavior technicians to break down skills into smaller components (Bak et al., 2021). DTT allows the researcher to break a specific skill down into its main components to teach it. DTT is often used in an applied behavior analysis clinical setting and at a structured setting (e.g., a table or desk) (Degli-Espinosa et al., 2020). When using DTT to teach tacting, a researcher will sit across from the child and will hold up a stimulus (e.g., play-food items, common classroom items) that the client

is prompted to tact (Dueñas et al., 2019). A vocal prompt is a common prompting strategy that researchers use (Bak et al., 2021) as it allows for the child to gain more independence without the use of a physical prompt.

Naturalistic Developmental Behavioral Interventions

Naturalistic developmental behavioral interventions (NDBI) involve instructional teaching procedures which are implemented in natural settings, involve shared control between child and therapist, utilize natural contingencies, and use a variety of behavioral strategies to teach developmentally appropriate and prerequisite skills (Schreibman et. al., 2015). In other words, this type of intervention follows the child lead. These interventions mainly occur in a play type setting, allowing the child to engage in play while also implementing teaching procedures. NET allows the child to maintain the desirable effects of playing while also allowing researchers to implement teaching methods (Schreibman et. al., 2015).

Comparing Discrete Trial Training and Natural Environment Training

While there have been many studies that examine the effects of teaching tacts in different instructional settings (e.g., natural environment training versus discrete trial training), such as, Dueñas et al. (2019) and LaLonde et al. (2020), there has been limited research directly comparing the two methods. The current study will examine the relationship between DTT and NET on how it affects tacting acquisition. Directly comparing these two methods will better allow practitioners to determine which instructional method to use when teaching tacting. This comparison will not only benefit practitioners, but it will also benefit the children and researchers. As previously mentioned, some clients may find DTT or NET aversive, and by comparing these two methods we can better determine which teaching method will work best for

the child. The purpose of the current study is to therefore test and compare the efficacy of discrete trial training and natural environment training on tacting acquisition.

Method

Participants, Setting, and Materials

Three young children who attended a community-based early intensive behavior intervention clinic for 32.5 hours each week and had a medical autism spectrum disorder diagnosis participated in this study (see Plavnick et al., 2020, for a description). A fourth participant was also considered but after initial pre-test testing it was determined he would not be a viable participant for this study due to his previous tact vocabulary. Participants received varying degrees of discrete trial tacting training and naturalistic environment tact training prior to this study. Participant's age ranged from 4-5 years old. Prior to the study, participants VB-MAPP scores were assessed to determine their current tacting skills, which are described in more detail below.

Participant 001 was 5 years old at the start of the study and had previously scored an 8.0 on the tacting portion of the VB-MAPP when she was last assessed in February of 2023. She is independently able to tact around 100 items without prompts and has been occasionally observed spontaneously tacting by the researcher and their supervisor.

Participant 002 was 4 years old at the beginning of the study. He had received a 4.0 on his tacting section of the VB-MAPP when he was last assessed in November of 2022 and is independently able to tact around 50 items with prompting. He was also observed to spontaneously tact by a supervisor and the researcher.

Participant 003 was 5 years old at the start of the study and had previously scored a 7.0 on her tacting section when her VB-MAPP was last assessed in November of 2022. She was able to independently tact around 250 items and would sometimes spontaneously tact as observed by her supervisor.

Sessions were conducted in the participants' classroom that was arranged for both DTT and NET teaching. Discrete trial training sessions took place at a small table where the researcher and child sat across from each other. Naturalistic environment teaching sessions took place on the floor in the play area section of the room. Six target items (3 items for DTT sessions and 3 for NET sessions) were identified for each participant during pre-test procedures described below. Teaching stimuli included items from a Bluey and Peppa Pig play set. Target stimuli included the following items, bucket, hammock, boat, see-saw, bench, fishing rod, stairs, chains, and corn. Other materials included individualized putative reinforcers, pretend-play items for play based sessions, and data collection materials.

Dependent Variable

The dependent variable was the percentage of correct tacts emitted during probe sessions. A correct response was defined as any instance in which the child said the name of the object within 5 seconds of object presentation. Each probe session, the number of correct responses was divided by the number of opportunities to respond and multiplied by 100 to yield the percentage of correct tacts emitted.

Design

A multiple baseline across participants design was used to compare DTT and NET teaching on tact acquisition. This design was chosen because it allowed for concurrent measurement across all participants, behaviors, and settings and allowed for measurement across all three conditions.

Procedures

Pre-Test

A pre-test was conducted before baseline sessions and teaching interventions to determine both if the student would be an appropriate participant for the study and to determine which stimuli the participant did not already know which could then be used in the study. Thirteen stimuli were chosen and then assessed for each participant. Pretest sessions were conducted in a quiet area of the classroom (an area different than where baseline and teaching sessions were conducted).

For each pre-test session, the researcher would hold up a stimulus and provide the S^D: "What is it?". A correct response was scored if the participant provided the name of the object within 5 seconds of object presentation. An incorrect response was recorded if the participant did not respond within 5 s or if the participant engaged in a vocal response that did not correspond with the item. Two pre-test sessions were run for each participant. Items that were scored as correct in either pre-test were removed from consideration.

Stimuli that the child was not able to correctly label across the two pre-test sessions were then written on slips of scratch paper, folded, and then placed into a bowl. The researcher then randomly selected six target stimuli for each participant out of the bowl. Three of these stimuli were then randomly assigned to either the DTT or NET condition.

Baseline

One baseline session of DTT and NET were conducted each day. Each baseline session consisted of 6 trials. The order in which target stimuli were presented was randomly determined using a random sequence generator. For each trial of each baseline session, the researcher held up the target stimulus and provided the S^D of "What is it?'. A correct response was defined as the

child correctly labeling the stimulus within five seconds. An incorrect response was recorded if the participant did not respond within 5 s or if the participant engaged in a vocal response that did not correspond with the item. No prompts or putative reinforcers were provided if the participant engaged in an incorrect or correct response, respectively.

Teaching

One pair of DTT and NET teaching sessions conducted per day for each participant and were separated by a short break. Each of the three stimuli for either the DTT or NET condition were presented three times in a random order determined by a random sequence generator for a total of 9 trials per condition (which are described in more detail below).

For both the DTT and NET teaching conditions, an echoic prompting system was used. During this prompting procedure, an immediate verbal prompt was given at first, and after two correct independent responses, the time delay was increased to three seconds, six seconds, and finally independence. Each participant began teaching sessions at an immediate verbal prompt when the target stimuli was first presented. A prompt was provided if the participant provided an incorrect response or did not provide a response in the time frame of 5 seconds. After two correct independent responses across a session, the prompting level was decreased. After two incorrect responses across a session the prompting level was increased. Reinforcement included social praise, edibles, and physical reinforcement (e.g., tickles, high fives). The prompting procedure and reinforcement was the same across the DTT and NET sessions. The specific components of the DTT and NET conditions are described in more detail below.

DTT Condition

The DTT condition was conducted at the student's usual table that they typically use in treatment sessions. During this session, the table was completely empty of other distractions and only the three target stimuli were used. The researcher would then hold up the target stimuli and prove the S^D of, "What is it?". If the student provided a correct response, reinforcement was provided in the form of an edible, social praise, or by letting the student engage in a preferred item for a short period of time before the next trial. If an incorrect response occurred, the error correction procedure was implemented in a manner described above.

NET Condition

The NET condition was conducted in the designated play area of the participants treatment room. During this condition, all target items, and other items in the play area, were available to the student. The researcher would then follow the child's lead with whatever toy they were engaging in. During this time, the researcher would then find opportunities to incorporate the target stimuli into play and provide the S^D of, "What is it?". If the student provided a correct response, the researcher would then allow the student to continue to engage in whatever they were playing with. If an incorrect response occurred, the error correction procedure was implemented in a manner described above.

Probe

Probe sessions were identical to that of baseline, except they were conducted immediately before each pair of DTT and NET teaching conditions. The purpose of the probe sessions was to evaluate the effects of the DTT and NET conditions on participant responding.

Interobserver Agreement

Interobserver agreement was calculated to evaluate the extent to which the primary researcher's measurement of the dependent variable corresponded to that of a second observer. Individual research sessions were selected for observation for a second observer using a random number generator for 30% of sessions across all conditions. Interobserver agreement data was collected on correct responses and errors across baseline, DTT, NET, and probe conditions. For each trial the researcher and second observer noted if the participant was correct or incorrect. An agreement was recorded if both observers independently scored the same response for each trial. IOA was calculated by dividing the number of agreements for each trial by the total number of trials and converting them to a percentage. The mean agreement across baseline sessions for participant 001 was 100%, for participant 002 100%, and for participant 003 100%. The mean agreement for the DTT condition for participant 001 was 100%, for participant 002 100%, and for participant 003 100%. The mean agreement for the NET condition for participant 001 was 100%, for participant 002 100%, and for participant 003 96% (range: 89-100%). Mean agreement for the probe session was 89% for participant 001 (range: 83-100%), 89% for participant 002 (range: 83-100%), and 78% for participant 003 (range: 66-100%).

Procedural Integrity

Procedural integrity data were collected for all experimental conditions to evaluate the extent to which the researcher implemented the experimental procedures as described. A second observer reviewed at least 20% of research sessions for each condition across all participants. Sessions were identified using a random number generator. Procedures that were assessed included twelve items, which included: researcher gathers all necessary materials for the session, session takes place at the participants usual table, researcher gathers toys and other necessary

materials for the session, researcher makes sure area is cleared of other distractions, researcher secures attention with participant (e.g., eye contact, hands on table), provides correct target stimuli, correct time delay is given to participant, correct prompt is implemented, researcher provides correct reinforcement, researcher ignored all off-task behavior, researcher collects data properly, and session will be terminated if participant engages in problem behavior for five or more minutes. Procedural integrity across all participants and across all conditions was 100%.

Results

Participant 1

Figure 1 depicts the number of correct independent tacts for participant 001 during baseline, the DTT intervention, and the NET intervention. During baseline, 001 did not tact any of the chosen stimuli determined in her pre-test, which can be seen in Figure 1. Upon introduction of both the DTT and NET teaching interventions, she immediately demonstrated an increased level of independent tacts. As seen in Figure 1, she was able to independently tact all target stimuli in fewer sessions in the DTT condition, as opposed to the NET condition. By session 14 she was able to independently tact 100% of target stimuli. Mean responding during intervention for the DTT condition was 79% (range: 11-100%), NET condition 58% (range: 0-100%), and probe condition 68% (range: 33-100%).

During probe sessions, Participant 1 reached 100% independent correct tacts for the three DTT target stimuli faster than the three NET target stimuli, as show in Figure 2. She was able to independently tact all target stimuli in probe sessions by session six, as opposed to the NET condition where she reached 100% independent tacts by session eight.

Participant 2

Figure 1 depicts the number of correct independent tacts for participant 002 during baseline, the DTT intervention, and the NET intervention. Participant 002 was discontinued from the current study after his eleventh session due to challenges associated with attendance and problem behavior. During baseline, he did not tact any of the chosen stimuli determined by his pre-test, which can be seen in Figure 1. This shows that the chosen target stimuli are not in his tacting repertoire. Upon introduction of the teaching interventions, he demonstrated an increased level of tacts for the NET condition as shown in Figure 1. Due to the insufficient number of

interventions, he was not able to show an increase in tacts for the DTT condition from baseline. Mean responding during intervention for the DTT condition was 0%, NET condition 22% (range: 0-22%), probe condition 33.5% (range: 17-67%).

During probe sessions, he was able to independently tact two target stimuli from both DTT and NET conditions as shown in Figure 2.

Participant 3

Figure 1 depicts the number of correct independent tacts for participant 003 during baseline, the DTT condition, and the NET condition. During baseline, she did not tact any target stimuli selected from her pre-test, which can be seen in Figure 1. This demonstrates that the response topographies were not in his tact repertoire. Upon introduction of the DTT and NET teaching interventions she immediately demonstrated an increased level of independent responding. As shown in Figure 1, she was able to independently tact all target stimuli in fewer session for the NET condition as opposed to the DTT condition. As by session 13 (including baseline sessions) she was independently able to tact 100% of NET target stimuli. She was not able to independently tact all target stimuli for the DTT condition, however she was able to reach 89% for the condition. Mean responding during intervention for the DTT condition was 59% (range: 0-89%), NET 68% (range: 0-100%), probe 70% (range: 17-100%).

During probe sessions she was able to independently tact 100% of target stimuli faster in the DTT condition, needing five sessions to reach 100%, as seen in Figure 2. She was also able to independently tact 100% of target stimuli from the NET condition, needing seven sessions to reach 100%.

Discussion

The primary aim of the current study was to test and compare the efficacy of DTT and NET teaching interventions on tacting acquisition. During the DTT condition, the researcher sat directly across from the participant and held up on of the three target stimuli. The researcher then provided the SD of "What is it?" and waited for the participant to provide a response. If the participant did not provide a response to the researcher, then the prescribed prompt was provided. This procedure aligns with the discrete trial training described by Dueñas and colleagues (2019).

During the NET condition target stimuli were incorporated into the play sequence for each participant and they could freely access those stimuli for most of the session. Additionally, the researcher spent most of the session following the child's lead. This procedure aligns with the naturalistic environment training described by Schreibman and colleagues (2015), where behavior analytic practices, such as tacting, are incorporated in an interactive play-based environment that replicate the antecedents and consequences of tacting outside of a clinical setting. Participants in this study reliably tacted target stimuli during intervention during both conditions.

Overall, the participants acquired tacts relatively quickly across both conditions. Participant 001 demonstrated a faster rate of acquisition for the DTT condition, reaching 100% independent tacting by trial nine for the teaching condition. Participant 001 was also able to reach 100% independent tacting for the target stimuli faster for the DTT target stimuli in the probe session as well, reaching 100% by session six. Participant 003 demonstrated faster acquisition in the NET condition. She was able to reach 100% independent tacting by session 12 for the NET condition, as opposed to the DTT condition where she did not reach 100%

independence. Interestingly however, she was able to reach 100% independent tacting for DTT target stimuli in the probe session quicker than the NET probe condition. She reached 100% independence for the DTT probe condition by session seven, and she reached 100% for the NET probe condition by session nine.

The different outcomes obtained for participants 001 and 003 suggest that there may be some similarities in mastery acquisition in the DTT condition. Both participants were able to reach 100% independence quicker for the DTT stimuli. These findings agree to other suggestions that show that children with ASD benefit from systematic interventions with consistent and explicit instruction (Bak, et al., 2021). This finding aligns with previous suggestions that show that acquisition of instructional targets in an NET context may not happen as quickly compared to DTT (Schreibman et. al., 2015). One possible explanation is that participant's may have had a longer learning history with a DTT context, therefore affecting acquisition. Second, the structure afforded by DTT may have been advantageous to acquisition, vs. the relatively less structure and more distractions inherent in NET instruction. Thirdly, the differences in stimuli between participant 001 and 003 could be a reason for the differences in target stimuli acquisition. However, this was most likely not the case because a pre-test was ran and target stimuli were randomized for each participant and for each condition. Lastly, the error correction procedure is also not a likely explanation, as the error correction procedure was kept consistent throughout both conditions.

The current study included a time delay fading procedure that appeared to be effective as participant 001 and 003 moved to answering some target stimuli independently as early as session two. However, the influence our prompting strategy had on the acquisition of tacts in the DTT and NET conditions, relative to other prompting strategies (e.g., textual prompts), is

unclear. Therefore, future research should not only compare acquisition in DTT and NET contexts, but also evaluate the role of different prompting strategies for those contexts.

The results of the probe session for each participant seem to suggest that the teaching conditions in the current study were effective. While participant 003 gained 100% independent tacting for the target stimuli faster in the NET teaching condition, she reached 100% independence for the DTT target stimuli quicker compared to the NET target stimuli for the probe sessions. This is also shown by participant 001, who also was able to reach 100% independence faster for DTT target stimuli in the probe session, however she also gained 100% independent tacting faster in the DTT teaching condition. These findings seem to suggest that the DTT teaching condition allowed for better generalization and maintenance than the NET teaching condition, however, these were not directly measured. Future studies could expand on these findings by increasing the time between probe sessions and by measuring maintenance over a longer period.

As previously mentioned, participant 002 was dropped from the current study. This was due to increased problem behavior during sessions and increased absences. However, there may have been some variables in the study that led to the increase in problem behavior. The sessions were quite long, with each session lasting about 20 minutes. This length of time may not have been suitable for the participant, and he may not have been fully motivated to attend for that length of time. The transitions during the sessions could have also proven difficult as there were three different transitions for when the clients moved from each condition. The client may also not have been motivated by the selected play items which could lead to a decrease in attending. It is also important to note that a new behavior plan was implemented for him shortly before intervention started.

The IOA for the probe sessions for participant 003 are also an issue of concern. Her mean IOA was 78%. There are several reasons for why the IOA is low. The camera and sound quality of the recording device used may not have been the best, meaning that the second observer may have had a difficult time hearing what the participant was saying. Secondly, the noise level in the treatment rooms was sometimes very loud, which again could make it difficult for the second observer to hear. The participant's articulation skills are also sometimes not very good, so the second observer may have mistaken a correct response for an incorrect one.

Limitations

While there were many important outcomes of the present study, several limitations also need to be addressed. In the NET condition, participants had access to all target stimuli. Therefore, it is possible that when the researcher picked up a target stimulus, the participants response may have been multiply controlled (e.g., partially controlled by an establishing operation). If this was the case, one would expect to see a decrease in responding over the trials as the participant would not have continued access to the stimuli in the probe and DTT sessions (LaLonde et. al., 2020). However, this was not the case with either participant as we saw an increase of responding over subsequent trials.

Another limitation was that each condition was run in the participants' classroom. Therefore, distractions from other students or instructors may have influenced participants responding. Also, two of the participants received therapy in the same room, while the other was in a different room in the school. The two participants in the same room may have observed the other's research sessions, therefore influencing their responding. In future studies, it may be beneficial to conduct sessions in a different space than the client's typical treatment room to mitigate the potential effects of observational learning.

Also, during the NET condition participants were given the S^D of "What is this?" or "What is it?". This antecedent condition may not resemble typical play scenarios. This antecedent was chosen for inclusion to provide a salient opportunity for the participant to respond. Future research may address this limitation by trying to contrive a more naturalistic way to have the student tact (e.g., "What's in the house?").

Participants were also similar in that their behavior was both reinforced by social praise and attention (e.g., tickles, high-fives) and in their pre-intervention language levels, and similar in age. The extent to which this study may apply to earlier language level learners and younger participants cannot be known. Future research may implement an inclusion criterion for participants, wherein it would limit certain ages and tacting repertoire students from participating in the study. This could in turn help make sure that participants are not able tact any of the chosen target stimuli and could also measure how these teaching conditions affect tacting in a younger population where their tacting skills might just be emerging.

Another limitation that needs to be discussed is the lack of generalization and maintenance measures. While the probe sessions may be interpreted as a measure of generalization, it was only the location that was different. The same researcher delivered each of the probe sessions every time and the novel location still occurred in the treatment room. Future research may expand on generalization by running probe sessions with new adults or peers and by changing the location to outside of the treatment room. The same set of stimuli for each participant for each condition were kept the same from session to session. LeBlanc (2006) recommends using multiple exemplars in both NET and DTT training to help increase generalization. In future studies, it would be beneficial to use multiple exemplars of target stimuli to help increase generalization.

The present study investigated the effects that different instructional settings have on tacting acquisition. The results ultimately showed that both the NET and DTT conditions were similar in tacting mastery progression. However, participants did generalize faster in the DTT condition opposed to the NET condition. This study shows that there may be benefits in teaching tacting in both a DTT and NET environment to increase the rate to independent tacting.

First Pre-Test Session

	001	002	003	004
Swing	x		x	x
Slide	x		x	x
See-Saw				x
Bench				x
Stairs				x
Chains				
Corn				x
Fishing Rod				
Bucket		x		x
Boat			x	x
Hammock				
Chair			x	x
Fire				x

Second Pre-Test Session

	001	002	003	004
Swing	x	x	x	x
Slide	x		x	x
See-Saw				x
Bench				
Stairs				x
Chains				
Corn				
Fishing Rod				
Bucket				X
Boat				X
Hammock				
Chair			x	X

Figure 1 Pre-test tally sheet

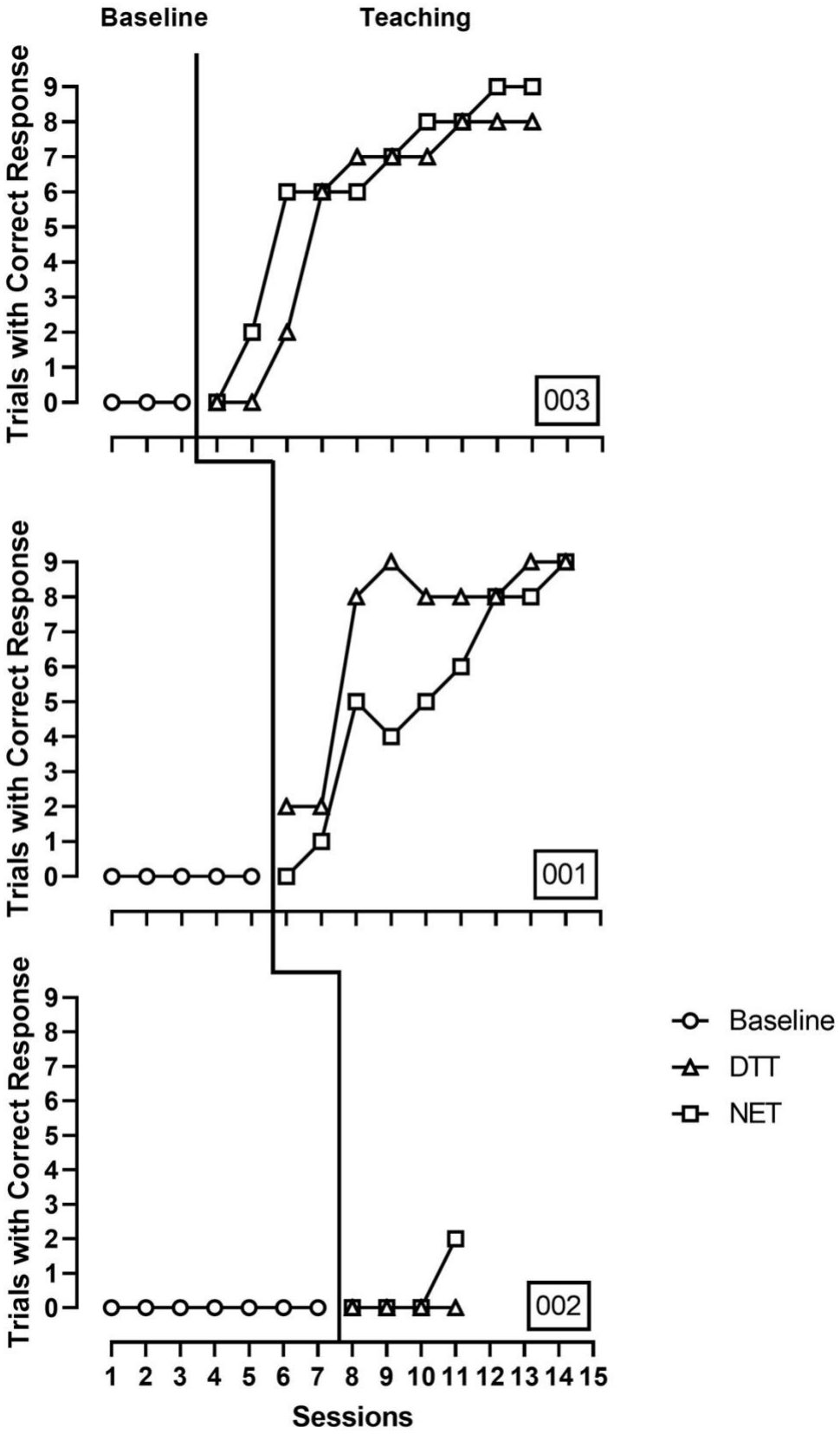

Figure 2 Teaching Conditions

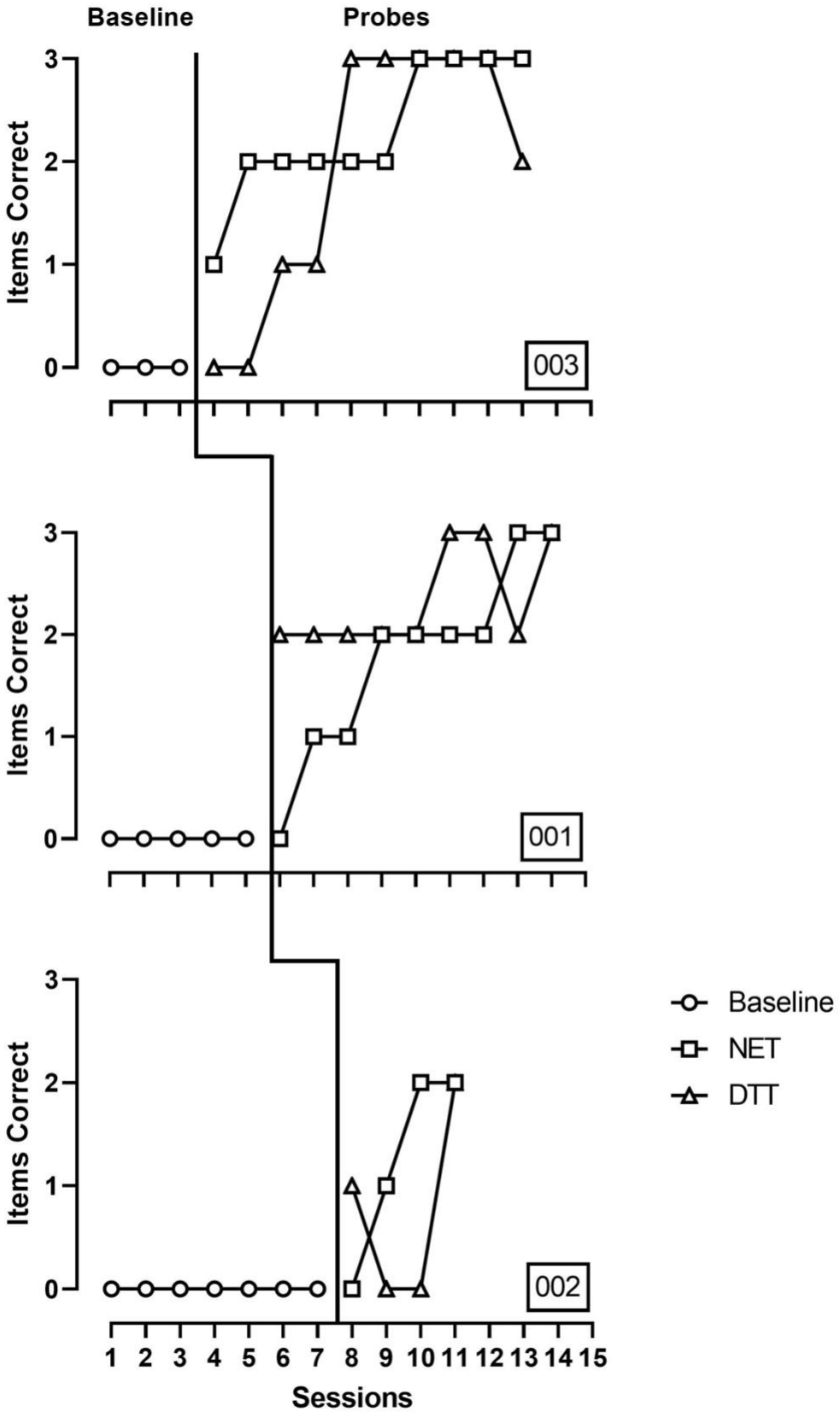

Figure 3 Probe Conditions

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