# Teaching Children with Autism to Tact Stimuli from Auditory and Tactile Sensory Modalities

by

Nicole M. Hanney

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Approved by

James E. Carr, Ph.D., BCBA-D, Chair, Professor of Psychology
Linda A. LeBlanc, Professor of Psychology
Christopher Newland, Professor of Psychology

## Abstract

A number of contemporary investigations have examined tact-training procedures with a number of different populations, specifically with children diagnosed with an autism spectrum disorder (e.g., Barbera & Kubina, 2005; Kelley, Shillingsburg, Castro, Addison, & LaRue, 2007; Stevens, Sidener, Reeves, & Sidener, 2005). All of the studies, however, have focused on teaching individuals to tact visual stimuli (2-D and 3-D), despite clinical recommendations to teach tacts of stimuli in other sensory modalities (Sundberg & Partington, 1998). In the current study, two children with autism were taught to tact auditory and tactile stimuli. The effectiveness of teaching the stimuli in isolation (e.g., auditory and tactile stimuli presented with no visual cues) and as compound stimuli (i.e., a toy that produced the auditory stimulus and an object covered in the tactile stimulus) was compared. Results indicate that while both teaching methods may be effective, using compound stimuli when teaching auditory and tactile tacts interfered with learners' prior tact repertoires.

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Skinner (1957) defined the tact relation as a verbal response under the control of a nonverbal discriminative stimulus ($S^D$) and maintained by generalized conditioned reinforcement. For example, when a child and caregiver see a dog walking on the street, the child may point to the dog and vocally respond “dog” (tact) upon seeing the actual dog (nonverbal $S^D$) to which the caregiver responds “That is a dog!” (generalized conditioned reinforcement). From the perspective of the speaker, no motivating operation (e.g., deprivation) related to the nonverbal $S^D$ is present, thus the listener’s response is nonspecific. This defining feature distinguishes the tact from the mand which is controlled by a motivative operation and specific reinforcement.

Skinner (1957) described the tact as the most important of the verbal operants because of the ability of listeners in the natural environment to provide nonspecific reinforcement that can function as an $S^D$ for additional verbal behavior. For example, a child reading a book with a caregiver might respond “elephant” to a picture of an “elephant” to which the caregiver responds, “That’s right! The elephant has big ears and lives in the jungle.” In this example, the elephant is the $S^D$ and the caregiver’s response acts as nonspecific reinforcement for the child’s verbal behavior if it strengthened that response in the future. The tact as a verbal operant allows for additional and crucial exposure to other verbal behavior through this interaction between speaker and listener.

**Tact Training**

Most children with autism who receive language intervention will be exposed to a tact training protocol. For example, Lovaas’ (2003) well-disseminated model of early intensive behavioral intervention (EIBI) classifies language targets as either expressive or receptive. Specifically, this model teaches the tact relation as “expressive labels.” Using a more Skinnerian approach, Sundberg and Partington's (1998) description of their verbal behavior approach to EIBI explicitly recommends tact training as a core feature of the curriculum. Consider the following example of a typical tact-training trial. A therapist shows a client a teddy bear (a photograph might also be used), says "What is this?" and waits for the client's response. If the client responds correctly with the tact "bear," the therapist provides the client with a form of nonspecific (e.g., a non-bear toy) and often generalized conditioned reinforcement (e.g., social praise). If the client does not respond or responds incorrectly, the therapist then might deliver an echoic prompt (e.g., "Say 'bear'") to evoke the response. Such prompts would then be faded out across trials until the client responds independently.

A variety of behavioral targets from the client's natural environment are often included in his or her specific tact program (e.g., foods, animals, body parts, vehicles) (Sundberg & Partington, 1998). The tact relation, in some form (e.g., tacts, expressive labeling), is included in all assessments commonly used to assess a client's language repertoire before beginning intervention. Consider as an example the Verbal Behavior Milestones and Placement Program (VB-MAPP; Sundberg, 2008). The VB-MAPP assesses 16 different domains, one of which is the tact relation. In this domain, a learner at Level 1 begins spontaneously tacting objects in the environment and ends at tacting 10 items without echoic prompts. A learner at Level 2 progresses from tacting 20 items, to actions, to noun-verb combinations, and then to at least 200 nouns and verbs. Finally, a learner at Level 3 tacts features/functions/classes, tacts prepositions and pronouns, tacts adjectives and adverbs, complete sentences with multiple words, and has an overall tact vocabulary of 1,000 words. Assessments such as the VB-MAPP assist clinicians in broadly determining the target repertoires to be taught (e.g., one-word tacts of objects vs. tacts of prepositions), but there are additional considerations regarding the stimuli to be tacted. For example, tact targets should be age-appropriate, easily spoken, and include objects with minimal reinforcing qualities because not delivering them after a response might evoke problem behavior.

**Recent Tact-Training Research**

A number of contemporary investigations have examined the general tact-training procedures described earlier with individuals with language impairments. The following is a summary of selected studies from this literature. For example, Stevens, Sidener, Reeve, and Sidener (2011) taught tacts to two males (ages 6 and 15 years) with pervasive developmental disorders. The tacted stimuli were pictures of items (e.g., avocado, garlic, marmot) that had a low probability of being contacted outside of the study. The experimental design was an alternating treatments design embedded within a multiple-baseline design across participants. During tact training, the researchers presented the target stimulus along with the question "What is it?" Depending on the experimental condition, participants received either behavior-specific praise (e.g., "That's right, that is the garlic!") and a token, general praise (e.g., "You did it. That's right!") and a token, or a token alone. Incorrect responses were followed by an echoic prompt (e.g., "garlic") from the researcher and then the presentation of the next target. The results showed that tacts were acquired similarly across all conditions.

Sundberg, San Juan, Dawdy, and Arguelles (1990) taught tacts to two adult males (ages 40 and 33 years) with severe verbal deficits who were diagnosed with acquired brain injuries. The tacted stimuli were three-dimensional (3-D) objects (e.g., electrical tape, crow bar, paper clip) and were chosen due to their relevance to the participants' occupation and familiarity prior to their accident. The effects of tact training were evaluated using a multiple-baseline design. During tact training, the researchers held the target object in front of the participant and asked "What is it?" No response after 5 s or an incorrect response was followed by an echoic prompt. If the participant provided the correct echoic prompt he received praise and the presentation of the next target object. If the participant failed to respond or responded incorrectly, the researcher responded with a mild “No” and the correction procedure was repeated. The researcher gradually faded any echoic prompts from the full word to the initial sound of the target. The authors demonstrated that their tact training protocol was successful in teaching all target tacts to both participants.

Wallace, Iwata, and Hanley (2006) taught signed tacts to three adults (ages 33, 35, and 40 years) diagnosed with moderate to severe intellectual disabilities. The tacted stimuli were high- and low-preference leisure items (e.g., music toy, bubbles, toy horn, toy bee, book) identified from preference assessments for each participant. The effects of tact training on the acquisition of signs was evaluated using a multiple-baseline design across participants. During tact training, the researcher presented each item to the participant along with the question “What is it?” Participants received a preferred edible item for correct responses. A nonresponse or an incorrect response was followed by the researcher modeling the correct target sign. After the model was provided, if the participant again engaged in an incorrect response or a nonresponse, the researcher physically guided the participant to perform the correct sign for the target stimulus. The results showed that the tacts were acquired for both high- and low-preference leisure items.

Twyman (1995) taught tacts to four preschool-aged children, 2 males and 2 females, diagnosed with language delays. The tacted stimuli were abstract properties (e.g., whole, large) of common 3-D leisure activities (e.g., coloring, legos, playdoh, puzzle) and tact training was evaluated using a reversal design. During tact training, for each stimulus the researcher presented an exemplar (e.g., whole crayon) and a nonexemplar of each target stimulus (e.g., part of a crayon). The researcher then modeled the correct tact (e.g., “whole crayon”) while pointing to the exemplar. Correct responses were followed by praise and access to an unrelated activity. Incorrect responses produced no response from the experimenter. After three correctly imitated tacts by the participant, the researcher re-presented the exemplar and the nonexemplar of the stimulus to the participant and waited for a correct tact. Praise was then provided for correct responses.  After tact training, all participants acquired the tacts of the target stimulus properties.

Barbera and Kubina (2005) taught tacts to one 7-year-old male diagnosed with autism and a mild intellectual disability. The tacted stimuli were pictures of common objects and household items and tact training was evaluated using a multiple-baseline design across responses.  During tact training, the target stimulus set was presented in an array in front of the participant.  The participant was instructed to “point to the…” target stimulus. If the participant repeated the targeted tact while pointing to the target stimulus, the researcher then held up that stimulus along with the prompt “Right, what is it?” If the participant did not respond or provided an incorrect response, the researcher provided the echoic prompt. After delivering the prompt, if the participant correctly imitated the tact, the researcher again provided the consequence “Right, what is it?” and waited for a correct response. Incorrect responses led to a new trial. The participant successfully acquired tacts for all three sets of stimuli.

Sigafoos, Doss, and Reichle (1989) taught tacts to three adults diagnosed with intellectual disabilities. The tacted stimuli were 3-D foods, beverage items, and utensils. The effects of tact training on the acquisition of a picture exchange system was evaluated using a multiple-probe design across responses. Since all of the participants used a picture exchange system prior to the study, the researchers used the same modality to teach the participants tacts of common utensils. An array of potential targets were included in each participant’s folder of known picture cards. During tact training, the researcher presented the target stimulus, the actual utensil, along with the prompt “What is this?” and then waited 10 s for the participant to select the corresponding picture card from the folder. If the participant did not provide the correct tact, the researcher physically guided the participant to select the correct card or pointed to the correct card depending on the intensity of prompting needed for the participant to engage in the correct response. Participants received specific verbal praise (e.g., “That’s right, it’s a spoon”) for all correct independent and prompted responses.  Upon completion of the study, all participants reliably tacted all of the target stimuli.

Nuzzolo and Greer (2004) taught tacts to four children (ages 6 to 9 years old) diagnosed with either autism or an intellectual disability. The tacted stimuli were 3-D adjective-object pairs (e.g., small cup, first box) and tact training was evaluated using a multiple-probe design across participants. During tact training, an array of three objects was presented to the participant while the researcher pointed to the target response. If the participant provided no response or an incorrect response, the researcher provided an echoic prompt (e.g., “That’s the small cup.”). Correct imitative responses were followed by praise and a token or sticker and incorrect responses were followed by the presentation of the next target. All participants acquired tacts for the target stimuli.

Marchese, Carr, LeBlanc, Rosati, and Conroy (2012) taught tacts to four children (ages 6 to 8 years old) diagnosed with autism. The tacted stimuli were 3-D objects commonly found in the natural environment (e.g., toys, books, hat) and tact training was evaluated using an adapted alternating treatments design embedded in a nonconcurrent multiple-baseline design across participants. During tact training, each participant was taught using two set of targets in which the object was presented with a question, “What is it?” or the object alone was presented. Upon the first presentation of either condition, the experimenter waited 3 s for a response. If the participant provided no response or an incorrect response, the experimenter provided an echoic prompt (e.g., “hat”). The experimenters delivered a preferred item and praise for correct responses and neutral praise for prompted responses. For two of the participants, the presence of the object alone was more effective, while for the other two participants, the additional question was more effective.

As the aforementioned studies indicate, teaching tact relations to individuals with autism and other disabilities has been relatively common in the contemporary research literature. All of the studies, including those not described here, however, have focused on teaching individuals to tact visual stimuli (e.g., 2-D picture, 3-D objects), despite clinical recommendations to teach tacts of stimuli in other sensory modalities as well. For example, Sundberg and Partington (1998) present guidelines on advanced tact training which describe the importance of auditory, tactile, olfactory, and gustatory tacts to a child’s language development. For example, in the natural environment an individual may tact “fire truck” upon hearing a “siren,” “cold” upon touching a popsicle, “gas” upon smelling a noxious substance, or “spicy” upon tasting a new food. Sundberg and Partington further illustrate the importance of an advanced tact repertoire by including recommendations to teach clients to tact private events (e.g., pain). Such repertoires are particularly important for individuals without sufficient verbal skills (e.g., a child tacting a stomach ache after eating a certain food). However, despite these clinical recommendations for a broad tact curriculum, there is a conspicuous absence of research on tacts of different sensory modalities.

Given the absence of research on teaching children with autism to tact nonvisual stimuli, additional research is warranted. These modalities are particularly relevant for investigation because they are transitory and presenting them in an impure form could potentially be detrimental to tact training. Consider the example of using a blanket to teach a child to tact "soft." The presence of the blanket (a visual stimulus) could lead to the child acquiring the tact "soft" for the blanket itself and not for its tactile quality. This same confound might occur when teaching a child to tact "siren" in the presence of a toy fire truck.

On the other hand, it might be more effective to include a visual stimulus when teaching a tact of a novel sensory modality (e.g., using a blanket to teach "soft") and may not be necessary to isolate the target tact. For example, if taught incidentally in a classroom setting, tacts of novel sensory modalities most likely would be taught using a toy or other compound stimulus (i.e., a stimulus with multiple features such as color, texture, sound). In the natural environment, children will more likely come in contact with compound stimuli, whether they hear a dog barking or feel a slimy frog. Teaching tacts of novel sensory modalities as compound stimuli could facilitate generalization to novel settings. However, previous studies, such as Lovaas, Koegel, and Schreibman (1979), have indicated that often children with an ASD are prone to overselective stimulus control, in which an irrelevant stimulus controls the response rather than a relevant stimulus. For example, if a child has a previous learning history of tacting the color "red," that same child may struggle with tacting a red ball as a "ball" and instead may tact that "ball" as "red." This common barrier to teaching children with autism might suggest that tacts of novel sensory modalities should be taught in isolation instead of as compound stimuli.

In addition to overselectivity, previous studies, such as Marchese, Carr, LeBlanc, Rosati, and Conroy (2012), have investigated the potential concern with the development of faulty stimulus control when an $S^D$ (e.g., "What is it?") precedes a visual tact in which the $S^D$ is evoking the tact instead of the stimulus itself. For example, "What is it?" may evoke the response of "ball" instead of the actual nonverbal stimulus of a "ball." This concern should be considered when tacting novel sensory modalities since a child should be able to tact both a visual stimulus (e.g., “What is it?”) and the tact of the novel sensory modality (e.g., “What sound do you hear?” “How does it feel?”) without the development of faulty stimulus control and the interference with prior tact repertoires (i.e., if teaching “What sound do you hear?” interferes with prior learning of “What is it?”).

Thus, a method must be developed that captures these sensory modalities without interference from other sensory modalities. The purpose of the present study was to develop and evaluate protocols for teaching tacts of auditory and tactile stimuli to children with autism. Auditory and tactile tacts were taught in isolation (e.g., *Isolated* condition) and as a compound stimulus (e.g., *Compound* condition) to determine the efficiency and effectiveness of both teaching techniques. In addition to the tact training, additional probes were also conducted to determine interference with prior tact repertoires and potential development of faulty stimulus control.

## Experiment 1: Tact Training with Auditory Stimuli

### Method

**Participants and setting.** Participants were two females, Marie and Rose, recruited from a local EIBI preschool for children diagnosed with autism and developmental disabilities. Both participants were diagnosed with an autism spectrum disorder. Marie was 3 years 10 months old and, according to the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008), scored 10/15 (Level 2 of 3) on the tact section indicating she was able to tact at least 200 nouns and/or verbs and 10 actions. She also scored 85/90 (Level 2 of 3) on the echoic portion of the VB-MAPP.  Rose was 3 years 4 months old and scored 8/15 (Level 2 of 3) on the tact section of the VB-MAPP indicating she was able to tact at least 150 nouns and/or verbs and 5 actions. She also scored 70/90 (Level 2 of 3) on the echoic portion of the VB-MAPP. Both participants were attending the EIBI preschool for approximately 30 hrs per week and were receiving 1:1 instruction for approximately 5-6.5 hrs per week.

All teaching trials occurred at the participants' preschool. Sessions took place in a therapy room to prevent other external stimulus modalities (e.g., auditory, visual, olfactory) from interfering with the target stimuli. The therapy rooms contained a room divider, two small tables and chairs for each side of the room, and plastic towers containing materials for students who received discrete-trial teaching (DTT) sessions in the room; both participants were taught in the room in which they received DTT during the typical school day. All teaching trials occurred at the small table with the experimenter and participant sitting in close proximity to one another. Each *session* was comprised of 9 trials and a *visit* lasted up to 30 min during which several sessions were conducted. Visits occurred at least once per day during 3 to 5 days a week depending on the participant's schedule.

**Materials.** As shown in Table 1, the two sets of auditory stimuli, *Isolated* or *Compound*, each contained three targets which were taught to both participants. All auditory stimuli were selected based on community and educational relevance and age appropriateness for the participants. In addition, all auditory stimuli had (a) a target tact that was not onomatopoetic (i.e., "buzz" as a tact for the *buzzzz* of a bee would not meet the criterion), (b) the target tact was different than the tact of the visual stimulus (i.e., "ring" as a tact for the *ringgg* of a telephone ringing would not meet the criterion), and (c) the auditory tact target also had to have a corresponding visual tact that was already in the participant's repertoire prior to training (i.e., if the tact for the visual stimulus of "turkey" was not already in the participant's tact repertoire, the tact for the auditory stimulus of "gobble" would not meet the criterion). The *Isolated* stimuli included a dog’s “howl”, a person’s “laugh,” and a turkey’s “gobble.” Also, since Rose began independently tacting “howl” as “puppy” during baseline sessions prior to training, a pig’s “squeal” was substituted for the dog’s “howl.” The *Compound* stimuli included a toy ambulance that produced a “siren,” a toy tiger that produced a “growl,” and a toy boat that produced a “horn.” During tact training, the participant would tact “howl” or “squeal,” “laugh,” and “gobble” for the *Isolated* condition and “siren,” “growl,” and “horn” for the *Compound* condition.

Using a decibel meter, all auditory stimuli in the *Isolated* condition were standardized to 65 decibels (dB), which is slightly louder than conversational speech. Each stimulus was presented to the participant using a sound file on a laptop computer with external speakers. The experimenter was oriented towards the computer screen while the participant was oriented towards the experimenter so that the participant was unable to view the visual stimulus on the computer screen itself. In order to standardize the presentation of the auditory stimuli, prior to each visit, the laptop speakers were placed in approximately the same location at the appropriate distance from the participant according to the volume indicated by the decibel meter. Each stimulus was presented in random order to the participant 3 times per session (3 trials x 3 stimuli).

In the *Compound* condition all stimuli were produced by the toy itself, so the stimuli could not be equated based on dB level. However, using a decibel meter that was placed approximately 6 in away from the toys, the following were the levels for each stimulus: the “siren” was 58 dB, the “growl” was 55 dB, and the “horn” was 53 dB. As in the *Isolated* condition, the experimenter and participant were oriented towards each other. The experimenter presented each toy to the participant while pressing the corresponding button on the toy that produced the auditory stimulus. The experimenter held each toy and did not provide access to the participant. Each stimulus was presented in random order to the participant 3 times per session (3 trials x 3 stimuli).

**Measurement and interobserver agreement.** For all tact training conditions, the dependent variable was the participants' vocal response, and was defined as either an *independent response*, a *prompted response,* an *incorrect response*, or a *no response*. A *correct response* was defined as the participant saying the name of the correct stimulus when presented with the target stimulus after hearing the corresponding $S^D$ (e.g., "What sound do you hear?"). A *prompted response* was defined as the participant saying the correct tact upon hearing the echoic prompt (e.g., "siren", "sticky") from the experimenter. An *incorrect response* was defined as the participant saying an incorrect name or an approximation other than the target tact stimulus. A *nonresponse* was defined as the participant not responding within 3 s of the $S^D$ or echoic prompt. The dependent measure was the percentage of correct tacts in a 9-trial session.

The first author (NH) served as the primary data collector for the current study. An undergraduate student served as the secondary data collector after being trained to proficiency prior to the study. The secondary data collector recorded data during the actual visit with the participant or at a later time from a recorded video of the visit. Correct, prompted, incorrect, and nonresponses were recorded on data sheets by the primary and secondary data collectors (see Appendix #1). Interobserver agreement (IOA) was calculated using the point-by-point agreement formula (agreements / [agreements + disagreements] X 100%). An agreement was scored when both the primary and secondary data collectors indicated a trial as either correct, prompted, incorrect, or a nonresponse. Agreement was assessed for 75% of all baseline and tact-training sessions, evenly distributed across conditions. Mean agreement was 100% for Marie and 100% for Rose.

**Procedures.**

***Preference assessment.*** Highly and moderately preferred tangible items were delivered for correct responses during tact training. To identify these items, the experimenter conducted a multiple-stimulus (without replacement) (MSWO) preference assessment (DeLeon & Iwata, 1996) prior to beginning tact training with each participant. Tangible items included in the assessment were based on parent and teacher report, classroom observations, and previous preference assessments. Immediately before the preference assessment began, the participant was given access to at least 7 various tangible items for 30 s each. The experimenter then placed an array of these items within reach of the participant who was then instructed to select one item. After the participant selected an item, the participant received approximately 10 s access to the item, after which it was removed from the array. The position of the remaining items was shuffled and the experimenter then instructed the participant to select another item. This process was continued until the participant selected all items and no items remained in the array. If at any time the participant did not select an item within 30 s of the presentation of the array, the experimenter ended the assessment and recorded all remaining items as unselected. The items were presented in three separate arrays. The rankings (1-7) for each item depending on the order in which they were selected were averaged across the three arrays and a preference hierarchy was created depicting high- to low-preference items for each participant. Those items not selected in an array received a ranking of 7 for that particular array. The experimenter then conducted a single-array MSWO preference assessment comprised of the top three items identified by the original MSWO with each participant before every visit. For Marie, the top three items identified by the original MSWO were princess figurines, a coloring book with markers, and a wand. For Rose, the top three items were a coloring book with markers, a microphone that played music, and books.

***Skill probes.*** Prior to tact training, the experimenter presented a variety of stimuli and the appropriate $S^D$ (e.g., "What sound do you hear?") and waited for a vocal response from the participant. No programmed consequences (e.g., delivery of a highly preferred tangible, praise) were provided for the participant's response. The experimenter randomly presented each target once to the participant. If the participant emitted a correct response (e.g., saying "ambulance," "siren," or any appropriate approximation when presented with the sound of a siren) for a particular target, then the experimenter excluded that particular target from the set and selected another target that did not evoke a correct response. If a target did not evoke a correct response after the one presentation, then that target was considered as a potential target for inclusion. Only those targets that did not evoke a correct response during these skill probes were included in the study.

***Experimental design.*** An alternating treatments design (i.e., *Isolated* vs. *Compound*) embedded within a multiple-baseline design across participants (i.e., Marie & Rose) was used to evaluate tact training of auditory stimuli.

***Baseline.*** During baseline sessions, the experimenter presented each target set according to the condition (i.e., *Isolated* vs. *Compound*). The experimenter presented the $S^D$ (i.e., "What sound do you hear?") and then the target auditory stimulus. After waiting approximately 3 s for a response, the experimenter then presented the next trial. Each target was randomly presented 3 times for a total of 9 trials per session (3 trials x 3 stimuli). No programmed consequences were delivered for independent responses.

***Tact training (isolated stimuli)*.** During tact training of auditory stimuli in the *Isolated* condition, the experimenter presented each auditory stimulus in that set (e.g., "howl" or "squeal," "laugh," "gobble") to the participant via a laptop computer as previously described. To facilitate attending to the stimulus, the experimenter prompted the participant to orient towards her while sitting in the chair at the table. The experimenter then presented the $S^D$ "What sound do you hear?" immediately followed by the auditory stimulus.  After the presentation, the experimenter waited approximately 3 s for a response. If the participant responded correctly (e.g., "siren"), the experimenter provided the participant access to a highly preferred tangible item for 30 s and delivered enthusiastic general praise (e.g. "That's right!", "Great job!"). If the participant responded incorrectly or provided no response, the experimenter prompted an echoic response (e.g., "siren") and then waited an additional 3 s. If the participant then provided the correct echoic response, the experimenter delivered enthusiastic general praise. If the participant provided an incorrect echoic response or did not respond, the experimenter began the next trial in which a new stimulus was presented. The experimenter continued this prompting procedure until all 9 trials were completed for that particular session. The acquisition criterion for the *Isolated* condition was 3 sessions at 100% correct over two consecutive visits. A failure criterion was also defined as 10 consecutive sessions below the acquisition criterion with no increasing trend after the stimulus set in the other condition reached the acquisition criterion. For example, if tacts in the *Compound* condition reached acquisition criterion prior to those in the *Isolated* condition, sessions of the *Isolated* condition would be continued until the participant either reached acquisition criterion or failure criterion for the *Isolated* condition.

***Tact training (compound stimuli)***. During tact training of auditory stimuli in the *Compound* condition, the experimenter presented each auditory stimulus in that set (e.g., "siren," “growl,” “horn”) to the participant as a toy that produced the target auditory stimulus as previously described. All other procedures were identical to those described earlier (*Tact training – Isolated stimuli*).

***Tact Training (mixed trials)*.** Because the results of the follow-up probes for the *Compound* tact-training condition indicated significant interference with the prior tact repertoire for Marie, the experimenter implemented a different auditory tact training condition with Marie in an attempt to prevent this contamination during training with compound stimuli. This additional auditory tact training was composed of a new set of 3 auditory tact targets and a series of mixed trials. The experimenter selected the targets using the same selection criteria as described earlier for auditory tact targets. The targets were trained as compound stimuli and the following were those toys with the corresponding auditory tact targets trained: a guitar producing a “strum,” a drum producing a “tap,” and the closing of a marker cap producing a “click.”

During *Mixed-Trials* training, the experimenter alternated one trial of an auditory tact (e.g., “What sound do you hear”) and one trial of the visual tact of that same toy (e.g., “What is it?”). The experimenter presented the trials in a 1:1 ratio of auditory to visual tacts. For example, using the same presentation procedure used during *Compound* tact training, the experimenter said “What sound do you hear?” and presented the auditory stimulus, a “strum” from the guitar. On the following trial, the experimenter said “What is it?” and presented the compound stimulus alone and not the auditory stimulus, meaning the guitar alone was presented without the “strum.” Because there were additional visual-tact trials for each auditory-tact trial, each session was a total of 18 trials (i.e., 9 trials of auditory, 9 trials of visual) instead of 9 trials. The experimenter conducted each training trial identical to the original *Compound* training condition with the addition of the "What is it?" trials. Acquisition and failure criteria are identical to those described earlier.

**Posttraining probes.**

***Follow-up probes*.** In order to assess maintenance of the auditory tact training, as well as generalization to the untaught condition (i.e., those targets taught in the isolated condition generalizing when probed as compound stimuli and vice versa), the experimenter conducted follow-up probes for both the *Isolated* and *Compound* conditions of auditory tact training.

First, for the *Isolated* condition, all 3 targets taught in isolation (e.g., "howl" or "squeal," "laugh," "gobble") were probed in isolation as they were originally taught at a 1-2 week follow-up after the set had met acquisition or failure criterion (i.e., 3 consecutive sessions at 100% accuracy over 2 consecutive visits). After presenting the $S^D$ "What sound do you hear?," the experimenter presented these targets in a random order to the participant as a single probe trial for each target. No consequences were provided following a participant's response or nonresponse, and the experimenter presented the next target until all 3 targets had been presented.

Then, these same 3 targets taught as isolated auditory stimuli were probed as compound stimuli. A toy was selected for each auditory tact target (e.g., dog or pig, doll, turkey, respectively) (see Table 1); each participant had the visual tact for each of these items already in her repertoire prior to training. The target tacts taught in isolation were recorded onto a small sound recording device. After presenting the $S^D$ "What sound do you hear?" the experimenter simultaneously played the target while presenting the corresponding toy to the participant (i.e., a toy dog was presented to the participant while the target "howl" was played from the device). The experimenter ensured that the sound recording device was kept out of sight of the participant so as not to interfere with the presentation of the toy. Again, no consequences were provided following a participant's response or nonresponse and the experimenter presented the next target until all 3 targets had been presented.

For the *Compound* condition, all 3 targets taught as compound stimuli (e.g., "siren," "growl," "horn") were also probed as compound stimuli as they were originally taught at a 1-2 week follow-up. The experimenter followed the same procedure as described earlier for the *Isolated* condition follow-up probes. In addition, as in the *Isolated* condition, these same 3 targets taught as compound auditory stimuli were probed as isolated stimuli. The experimenter recorded the auditory stimulus produced by each toy used in the *Compound* condition and transferred them to a laptop computer. The experimenter then played these three targets via laptop computer to the participant as was conducted during the *Isolated* condition training and used the same procedure as described above for the *Isolated* condition follow-up probes.

The experimenter conducted additional follow-up probes, as well as interference with prior tact probes.

***Probes of interference with prior tacts***. After the experimenter conducted the follow-up probes, the experimenter also conducted additional probes to assess the potential interference with the prior visual tact of each target taught either in isolation or as a compound stimulus. Prior to beginning training, all of the targets used in the *Isolated* and *Compound* conditions were probed as visual tacts with the $S^D$ "What is it?" and as either 2D stimuli (e.g., picture cards) or 3D stimuli (e.g., a corresponding toy that produced the target auditory stimulus). For example, the visual tact for an object that produces the target "siren" was an ambulance. The experimenter presented a 2D stimulus of an ambulance to the participant and asked "What is it?" The experimenter then presented a 3D stimulus or toy ambulance to the participant and asked "What is it?” The experimenter presented both 2D and 3D stimuli for all 6 targets used in auditory tact training. Prior to tact training, Marie and Rose correctly tacted the visual stimulus for both 2D and 3D stimuli for all 6 targets.

During the probes to assess interference with these prior visual tacts, the experimenter presented each 2D and 3D stimulus following the $S^D$ “What is it?” to the participant for each target. No programmed consequences were delivered for a participant’s response or nonresponse and the experimenter presented the next trial. As in the follow-up probes, each target for 2D and 3D stimuli was presented as a single trial. For the *Isolated* condition, the experimenter presented 2D picture cards of a “dog” or “pig,” “doll,” and “turkey” to correspond with the targets taught in isolation, “howl” or “pig,” “laugh,” and “gobble.” The same targets were then presented as 3D stimuli or toys. These same toys were those used in the follow-up probes for the *Isolated* condition described above.

For the *Compound* condition, the experimenter followed the same procedure described above, except using those targets taught in the *Compound* condition. The experimenter presented 2D picture cards of an “ambulance,” “tiger,” and “boat” to correspond with the targets taught as compound stimuli, “siren,” “growl,” and “horn.” The 3D stimuli or toys used to teach these targets were then used as the stimuli for these probes.

**Procedural integrity.** All visits were recorded using a video camera to enable procedural integrity assessment. Two trained observers viewed the videos at a scheduled time and assessed the experimenter’s implementation of the training procedures. The observers collected data on the experimenter’s correct delivery of the $S^D$ (e.g., “What sound do you hear?”, “How does it feel?”) depending on the trial type, appropriate error correction used (e.g., providing a vocal model prompt or no response), and delivery of the correct consequence given the participant’s response (e.g., highly preferred item as identified by participant's preference assessment, praise) using data sheets provided by the experimenter (see Appendix #2). Procedural integrity was assessed for 40% of all tact-training sessions. Point-by-point IOA was also assessed for 40% of the procedural integrity data. For both participants, procedural integrity data were summarized as a percentage correct score for each session. For auditory tact training for Marie, procedural integrity averaged at least 83.3% and IOA averaged at 100%. For auditory tact training for Rose, procedural integrity averaged at least 83.3% and IOA was 100%.

## Results and Discussion

### Results

***Tact training evaluation.*** The results of the auditory tact training for both Marie and Rose are displayed in Figure 1. During baseline sessions, Marie (top panel) did not emit any independent responses for both the *Isolated* and *Compound* conditions. During the second baseline session, Rose (bottom panel) tacted an approximation of the target "howl" (i.e., Rose tacted "puppy" in response to "howl") even though previously she had not responded to this target during the pre-treatment skill probes. No programmed consequences were delivered during these trials. The experimenter then began the next baseline session including a new target (e.g., "squeal"). The baseline data displayed for Rose are those sessions after the new target was included in the *Isolated* condition.

For the *Compound* condition, Marie acquired the target set in 15 sessions. However, in the *Isolated* condition, after 25 sessions she reached the failure criterion. Marie never tacted the target "laugh" and typically emitted no response during prompting for this target. For the *Compound* condition, Rose acquired the target set in 14 sessions. However in the *Isolated* condition, after 23 sessions she reached the failure criterion. While Rose did emit some independent responses per session (range 0%-44%), she did not emit any independent responses during 17 of the 23 sessions.

For the *Mixed Trials*, Marie acquired the auditory tact target set in 17 sessions. Upon acquiring the skill, she also responded at 100% independent responses for the visual tact of each target (i.e., "What is it?") during the last 3 sessions of training.

***Posttraining probes.*** The results of the posttraining probes are displayed in Figure 4. For the *Isolated* condition follow-up probes, Marie independently tacted 2 out of the 3 targets (67%). For those isolated stimuli probed as compound stimuli, Marie also independently tacted 2 out of the 3 targets (67%). For the *Compound* condition, Marie independently tacted all 3 targets (100%). For those compound stimuli probed as isolated stimuli, Marie did not independently tact any of the targets. For the *Isolated* condition follow-up probes and those isolated stimuli probed as compound stimuli, Rose did not independently tact any of the targets (0%); however, this deficit could be attributed to the fact that Rose did not consistently independently tact the targets during actual training for the *Isolated* condition. For the *Compound* condition, Rose independently tacted all 3 targets (100%). For those compound stimuli probed as isolated stimuli, she also independently tacted all 3 targets (100%).

For the *Isolated* condition probes of interference with prior tact, Marie independently tacted all 3 targets (100%) for both 2D and 3D stimuli. For the *Compound* condition, Marie only independently tacted 1 out of 3 targets (33%) for 2D stimuli and did not independently tact any of the targets (0%) for 3D stimuli. For the *Isolated* condition probes of interference with prior tact, Rose independently tacted all 3 targets (100%) for both 2D and 3D stimuli. For the *Compound* condition, Rose independently tacted all 3 targets (100%) for 2D stimuli and did not independently tact any of the targets (0%) for 3D stimuli.

For the *Mixed Trials* follow-up probes, Marie independently tacted all 3 targets (100%). For those compound stimuli probed as isolated stimuli, Marie only tacted 1 out of the 3 targets (33%). For the Mixed Trial probes of interference with prior tact, Marie independently tacted all 3 targets (100%) for both 2D and 3D stimuli.

**Discussion**

Overall for auditory tact training, both Marie and Rose acquired the skill in the *Compound* condition but not in the *Isolated* condition. These results could be interpreted that teaching an auditory tact as a compound stimulus is more efficient; however, the results of the posttraining probes for the *Compound* condition showed that interference with the prior tact was present for both participants. This contamination of the prior tact repertoire was not seen during the posttraining probes for the *Isolated* condition. While the *Compound* condition appears to be more efficient, the contamination shown during the post-training probes would be detrimental to a learner's tact repertoire if not detected after acquisition.

The *Compound* condition could be more efficient due to the presence of a visual stimulus during training which was not present during the *Isolated* condition. Typically, a learner with a history of receiving EIBI services displays instructional control during teaching sessions. During these sessions, the learner attends to the therapist and often an array of visual stimuli used for teaching trials. The presence of the visual stimulus in the *Compound* condition could have been similar to a learner's typical teaching sessions. This visual stimulus could then have been evoking a stimulus generalization of learner behavior; therefore, increasing the efficiency of these sessions. However, since there was no visual stimulus to attend to during the *Isolated* condition, the same stimulus generalization may not have been present, which could have impeded acquisition and decreased the efficiency of teaching sessions.

Even though the *Compound* condition appears to be more efficient, the interference with the prior tact is problematic to a learner's tact repertoire. Since the $S^D$ of "What sound do you hear?" and "What is it?" are similar in structure, faulty stimulus control could have been formed in which the $S^D$ of "What…?" was actually controlling the tact response instead of the actual auditory stimulus (Marchese, Carr, LeBlanc, Rosati, & Conroy, 2012), . Therefore, during the post-training probes, the participants' newly acquired tact under the control of "What sound do you hear?" still controlled responding even when "What is it?" was presented, which could have caused the contamination to occur. On the other hand, instead of the type of $S^D$ causing faulty stimulus control to occur, the visual stimulus itself could have been controlling responding (Grow, Carr, Kodak, Jostad, & Kisamore, 2011). Overselectivity could have been a factor if the visual stimulus was controlling responding instead of the auditory stimulus, which also could have interfered with the prior tact.

Due to the aforementioned hypotheses for the interference with the prior tact, for Marie, the experimenters implemented a *Mixed Trials* training using compound stimuli in which the $S^D$ of "What sound do you hear?" was followed by a trial of the $S^D$ "What is it?" While this training method was comparable in efficiency to the original *Compound* condition, the *Mixed Trials* training also eliminated the interference with the prior tact. At the end of training, Marie was independently tacting both the auditory stimuli and the 2D and 3D visual stimuli for the 3 targets. This method of interspersing trials could have disrupted the faulty stimulus control from occurring by distinguishing the two $S^D$ s. Instead of the instruction controlling responding, now the presence or absence (i.e., the visual stimulus present alone) of the auditory stimulus was controlling responding.

## Experiment 2: Tact Training with Tactile Stimuli

### Method

**Participant and setting.** Marie participated in Experiment 2. The setting was the same as described for Experiment 1.

**Materials.** As shown in Table 1, tactile stimuli were categorized into *Isolated* and *Compound* sets, each with 3 targets taught to the participant. The *Isolated* stimuli included "soft," "smooth," "bumpy," while the *Compound* stimuli included a triangle that was "sticky," a heart that was "scaly," and a star that was "rough." Those shapes used for the compound tactile stimuli were chosen because the participant had these visual tacts already in her repertoire. All tactile stimuli were selected from types of materials similar to those found in the *Touch and Feel* (DK Publishing, 1998) series books and those which would be common in a typically developing preschooler's natural environment.

In the *Isolated* condition, each stimulus was presented individually to the participant as a square of material approximately 18X8 in, covering the entire bottom of the apparatus and corresponding to the appropriate texture was presented individually to the participant. A blanket was used for "soft," cardstock was used for "smooth," and plastic beads from necklaces were used for "bumpy." Each stimulus was placed in a "Tactile Discovery" box so that the participant was unable to visually view any portion of the stimulus. The "Tactile Discovery" box containing the stimulus was individually presented to the participant and the experimenter instructed the participant to place her hand in the box (only during *Apparatus Training* trials). The opening of the box was large enough for the participant's hand to slide into to feel the stimulus and was small enough to prevent the participant from visually viewing any portion of the stimulus.

In the *Compound* condition, each stimulus was presented as a shape (e.g., triangle, heart, star) created from cardstock on which the target tactile stimulus was covering the entirety of the shape. The underside of duct tape covered the triangle to create “sticky,” a sequined material covered the heart to create “scaly,” and sandpaper covered the star to create “rough.” Each shape was created to be large enough for the participant to feel the target tactile stimulus. The triangle, heart, and star were all approximately 3X3 in. Each stimulus was presented and randomized to the participant 3 times for a total of 9 trials per stimulus.

**Measurement and interobserver agreement.** Response measurement and IOA calculation were identical to Experiment 1. Mean IOA was at 100%.

**Procedures.**

***Preference assessment.*** The preferred items identified during Experiment 1 were delivered in this experiment.

***Apparatus training*.** The experimenter taught Marie to place her hand inside the apparatus used to cover each tactile stimulus and touch the target stimulus inside. The experimenter taught her to touch each tactile stimulus using the apparatus when presented with the $S^D$ “How does it feel?” using a standard least-to-most prompting procedure. Because the top of the apparatus could be removed, the experimenter was able to look inside the apparatus during this training to ensure that Marie was engaging in the appropriate feeling response after placing her hand in the apparatus. After only 3 training trials, Marie reliably placed her hand in the apparatus in the absence of prompts and only following the $S^D$ “How does it feel?” she continued to respond correctly to the apparatus throughout the remainder of the tactile tact training.

***Skill probes.*** Skill probes were conducted to identify target stimuli using the procedures described in Experiment 1.

***Experimental design.*** An alternating treatments design (i.e., *Isolated* vs. *Compound*) was used to evaluate the effects of tact training with Marie.

***Baseline.*** During baseline sessions, the experimenter presented each target set according to the condition (i.e., *Isolated* vs. *Compound*). The experimenter presented the $S^D$ (i.e., "How does it feel?") and then the target auditory stimulus. After waiting approximately 3 s for a response, the experimenter then presented the next trial. Each target was randomly presented 3 times for a total of 9 trials per session (i.e., 3 presentations of each of the 3 targets in a set). No programmed consequences were delivered for independent responses.

***Tact training (isolated stimuli)***. During tact training of *Isolated* tactile stimuli, the experimenter presented each target tactile stimulus (e.g., "soft," "smooth," "bumpy") inside the apparatus as previously described. To facilitate attending to the stimulus, the experimenter prompted the participant to orient towards her while sitting in the chair at the table. The experimenter then presented the instruction "How does it feel?" and waited approximately 3 s for the participant's response. The experimenter then followed the prompting procedure as described earlier in Experiment 1 (*Tact training – Isolated auditory stimuli*). The acquisition and failure criterions were also identical to Experiment 1. The experimenter continued this prompting procedure until all 9 trials had been completed for that particular session.

***Tact training (compound stimuli)***. During tact training of tactile stimuli in the *Compound* condition, the experimenter held each tactile stimulus in that set (e.g., "sticky," "scaly," "rough") and presented each one in the set to the participant as previously described. All other procedures were identical to those described earlier in Experiment 1 (*Tact training – Isolated stimuli*).

**Posttraining probes.**

***Follow-up probes***. In order to assess maintenance of the auditory tact training, as well as generalization to the untaught condition (i.e., those targets taught in the isolated condition generalizing when probed as compound stimuli and vice versa), the experimenter conducted follow-up probes for both the *Isolated* and *Compound* conditions of tactile tact training.

For the *Isolated* condition, all 3 targets taught in isolation (e.g., "soft," "smooth," "bumpy") were probed in isolation as they were originally taught using the same apparatus at approximately a 1-2 week follow-up after the set had met acquisition or failure criterion. After presenting the instruction "How does it feel?" the experimenter used the same procedure described above in *Experiment 1* (*Posttraining probes – Follow-up probes*).

Then, these same 3 targets taught as isolated tactile stimuli were probed as compound stimuli. A shape was created out of cardstock for each tactile tact target (e.g., square, diamond, circle) (see Table 1); each participant had the visual tact for each of these items already in her repertoire prior to training. The experimenter then covered each shape with a material used in isolation for each target; the square was covered in beads for "bumpy," the diamond in cardstock for "smooth," and the circle in a piece of a blanket for "soft." Again, after asking "How does it feel?" the experimenter presented each compound stimulus to the participant using the same procedure described above.

For the *Compound* condition, all 3 targets taught as compound stimuli (e.g., "sticky," "scaly," "rough") were also probed as compound stimuli as they were originally taught at approximately a 1-2 week follow-up after the set had met acquisition or failure criterion. The experimenter followed the same procedure as described above. Also, these same 3 targets taught as compound tactile stimuli were probed as isolated stimuli. The experimenter covered the bottom of the apparatus used in the *Isolation* condition with the same materials (e.g., tape, sequin material, sandpaper) used during the *Compound* condition. The experimenter then presented the apparatus to the participant using the same procedure describe above for each target.

***Probes of interference with prior tacts.*** After the experimenter conducted the follow-up probes, the experimenter also conducted additional probes to assess the potential interference with the prior visual tact of each target taught either in isolation or as a compound stimulus. In addition to the interference with prior tact probes for the auditory stimuli, the experimenter also conducted these same probes using the same procedure describe above for 2D and 3D stimuli for the 6 tactile targets taught in either the *Isolated* or *Compound* tactile tact training condition. Again, prior to implementing tactile tact training, Marie and Rose correctly tacted the visual stimulus for both 2D and 3D stimuli for all 6 targets.

For the *Isolated* condition, the experimenter presented 2D picture cards of a "circle," "square," and "diamond." The same targets were then presented as 3D stimuli created out of cardstock and covered in the corresponding material for target tactile tact. The same targets were those used in the follow-up probes for the *Isolated* condition described above.

For the *Compound* condition, the experimenter followed the same procedure described above, except using those targets taught in the *Compound* condition. The experimenter presented 2D picture cards of a "triangle," "heart," and "star" to correspond with the targets taught as compound stimuli, "sticky," "scaly," and "rough." The 3D stimuli or shapes covered in the material used to teach these targets were then used as the stimuli for these probes.

**Procedural integrity.** The procedures to assess procedural integrity were identical to those used in Experiment 1. Procedural integrity was assessed for 40% of all tact-training sessions. IOA was also assessed for 40% of the procedural integrity data. For Marie, procedural integrity data were summarized as a percentage correct score for each session. For tactile tact training for Marie, procedural integrity averaged at least 83.3% and IOA averaged at least 100%.

## Results and Discussion

### Results.

***Tact training evaluation.*** The results of the tactile tact training for Marie are displayed in Figure 2. During baseline sessions, Marie did not emit any independent responses for both the *Isolated* and *Compound* conditions.

For the *Compound* condition, Marie acquired the target set in 14 sessions. However in the *Isolated* condition, after 24 sessions she reached the failure criterion. Marie never tacted the target “soft” and typically emitted no response during prompting for this target.

***Posttraining probes.*** The results of the posttraining probes are displayed in Figure 3. For the *Isolated* follow-up probes, Marie independently tacted 2 out of the 3 targets (67%). For those isolated stimuli probed as compound stimuli, Marie did not independently tact any of the targets (0%). For the *Compound* condition, Marie independently tacted all 3 targets (100%). For those compound stimuli probed as isolated stimuli, Marie independently tacted 1 out of the 3 targets (33%). For the *Isolated* condition probes of interference with prior tact, Marie independently tacted all 3 targets (100%) for both 2D and 3D stimuli. For the *Compound* condition, Marie also independently tacted all 3 targets (100%) for both 2D and 3D stimuli.

### Discussion.

Overall for tactile tact training, Marie acquired the skill in the *Compound* condition but not the *Isolated* condition. The results of the post-training probes showed that interference with the prior tact was not present for either the *Isolated* condition or the *Compound* condition.

However, those stimuli trained in isolation did not transfer over when probed as compound stimuli and vice versa.

Since most tactile stimuli in the natural environment will be encountered as compound stimuli (e.g., a soft blanket, smooth rocks), training tactile stimuli as compound stimuli could be effective due to its efficiency and no interference with the prior tact. However, future studies might consider investigating training with a combination of both isolated and compound stimuli for the same target to increase the likelihood that the target will transfer over to both conditions. Future studies might also include other novel stimuli that are commonly found in the natural environment, such as teaching the discriminations between hot and cold or wet and dry.

**General Discussion**

While a long line of tact training research exists in the literature, all of the present studies used visual 2D and 3D stimuli during training. The current study extends the literature by teaching tacts of novel sensory modalities, specifically auditory and tactile tacts, to children with autism. Overall, for auditory training, the present study determined that while teaching the stimuli as compound stimuli (i.e., *Compound* condition) as compared to isolated stimuli (i.e., *Isolated* condition) was more efficient for both Marie and Rose, an interference with the prior tact was shown during follow-up probes for the compound stimuli. Upon the completion of mixed trials training for Marie, training as compound stimuli was equally as efficient but with no contamination of the prior tact. For tactile training, similar results in efficiency for compound stimuli as compared to isolated stimuli were shown for Marie. Unlike auditory training, during follow-up probes no interference of the prior tact was shown for the compound stimuli; however, robust transfer was not shown across presentation methods (i.e., compound to isolated, isolated to compound).

Despite showing similar effects across participants and across Experiment 1 and 2, a few limitations can be addressed. In regards to the sets being differential across participants, this concern could have had an effect on the acquisition of each participant; however, replication across participants was shown meaning that the sets were not differential. For the auditory tact training, after completion of the mixed trials training for Marie, a replication of effects of original tact training was shown; however, the mixed trial training was only completed with the one participant. For the tactile tact training, a demonstration of an effect (i.e., compound acquired more quickly, no acquisition in isolated) was shown; however, a replication of the efficiency effect was not shown since only one participant was included in this portion of the study. For the follow-up probes, repeated measures could have been included instead of only one trial presentation of each of the targets. Additionally, the follow-up probes were conducted approximately 1-2 weeks after acquisition, which could have been increased to a longer time period (i.e., one month follow-up).

Since this study is the first in the line of research investigating tacts of novel sensory modalities, several future directions are crucial in examining further this type of training. Replications need to be conducted for both isolated and compound training conditions, specifically in regards to mixed trial training, to determine the effectiveness of this method. For the compound method, future studies need to determine if teaching as compound stimuli with mixed trial training is a useful teaching method. For the isolated method, the method of presentation needs to be evaluated and additional components added if necessary to increase its efficiency. For example, if training stimuli in isolation, particularly during auditory tact training, the inclusion of an observing response, such as having the learner pressing a button to present the stimulus, could promote attending and facilitate acquisition. Most importantly, future investigations are needed to determine if teaching a target as both an isolated and compound stimulus with the inclusion of mixed trials could facilitate the transfer from condition to the other and eliminate contamination of the prior tact.

While this study conducted follow-up probes approximately 1-2 weeks after acquisition of the target set, future studies could conduct longer term follow-up probes to further investigate maintenance of the skill. In regards to types of stimuli to include, while the current study only investigated auditory and tactile modalities, future studies could include the other modalities, such as olfactory and gustatory. Additionally, stimulus generalization could be assessed by including several forms of the same stimulus. For example, different types of sirens instead of one type of siren could be included during training.

***Preliminary clinical recommendations.*** Based on our present study despite needing further replication in future studies, a few clinical recommendations can be made for teaching tacts of novel sensory modalities, specifically auditory and tactile tacts. Since EIBI curricula (Sundberg & Partington, 1998) state the need to teach a learner tacts of novel sensory modalities but with no explicit instructions, the following recommendations could be useful to practitioners attempting to teach this skill. The preliminary recommendations are divided into three categories: stimuli selection, teaching method, and follow-up probes.

- Stimuli selection: When selecting stimuli to include in a learner’s tact training, the stimuli should have a corresponding visual stimulus which the learner already has the tact for in her repertoire. This presence of the visual stimulus would then allow the practitioner to investigate if faulty stimulus control had developed and if any interference with the prior tact was present through an analysis of the follow-up probes.

- Teaching method: Using a mixed trials training procedure in which the practitioner presents a “What is it?” trial followed by a “What sound do you hear?” or “How does it feel?” trial might prevent potential faulty stimulus control from developing. Additionally, in order to promote transfer across isolated and compound stimuli, practitioners could teach a stimulus as both an isolated stimulus and compound stimulus.
- Follow-up probes: Following acquisition, a practitioner should conduct additional follow-up probes to investigate maintenance of the targets, transfer to the opposite condition (i.e., compound to isolated or isolated to compound), and interference with the prior tact.

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Table 1

*Auditory and Tactile Target Stimuli Sets*

| Stimulus Modality | Tact Target | Object |
|---|---|---|
| *Auditory* | | |
| Isolated | Howl | Dog |
| | Laugh | Doll |
| | Gobble | Turkey |
| Compound | Siren | Car |
| | Growl | Tiger |
| | Horn | Boat |
| *Tactile* | | |
| Isolated | Soft | Circle |
| | Smooth | Diamond |
| | Bumpy | Square |
| Compound | Sticky | Triangle |
| | Scaly | Heart |
| | Rough | Star |

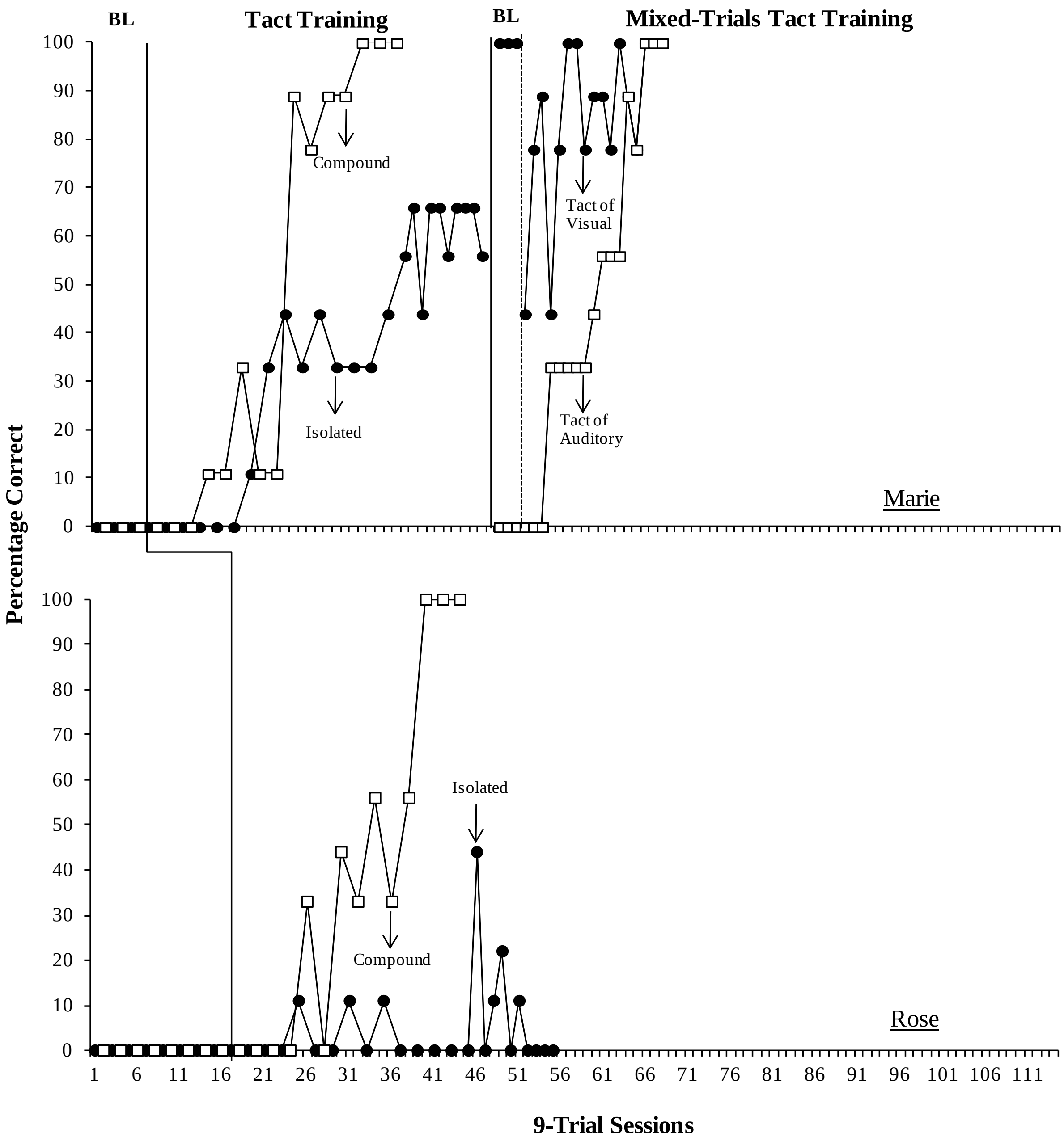


*Figure 1.* Auditory Tact Training: baseline and acquisition data comparing *Isolated* and *Compound* conditions for Marie (including *Mixed Trials*) (top panel) and Rose (bottom panel).

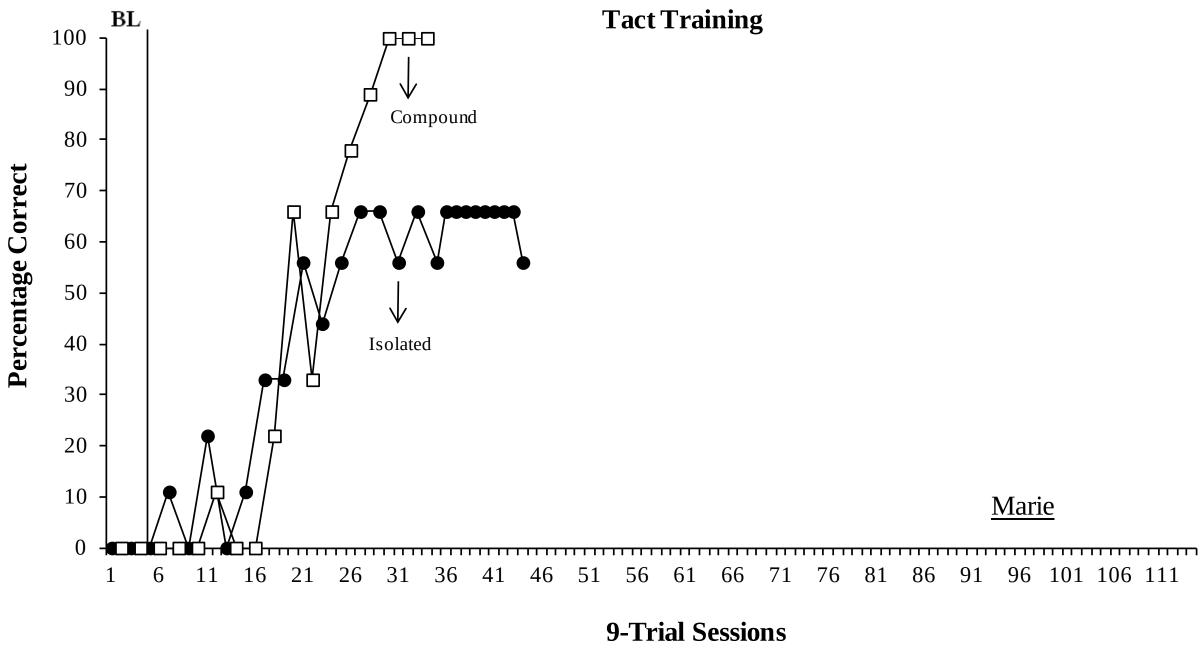


*Figure 2.* Tactile Tact Training: baseline and acquisition data comparing *Isolated* and *Compound* conditions for Marie.

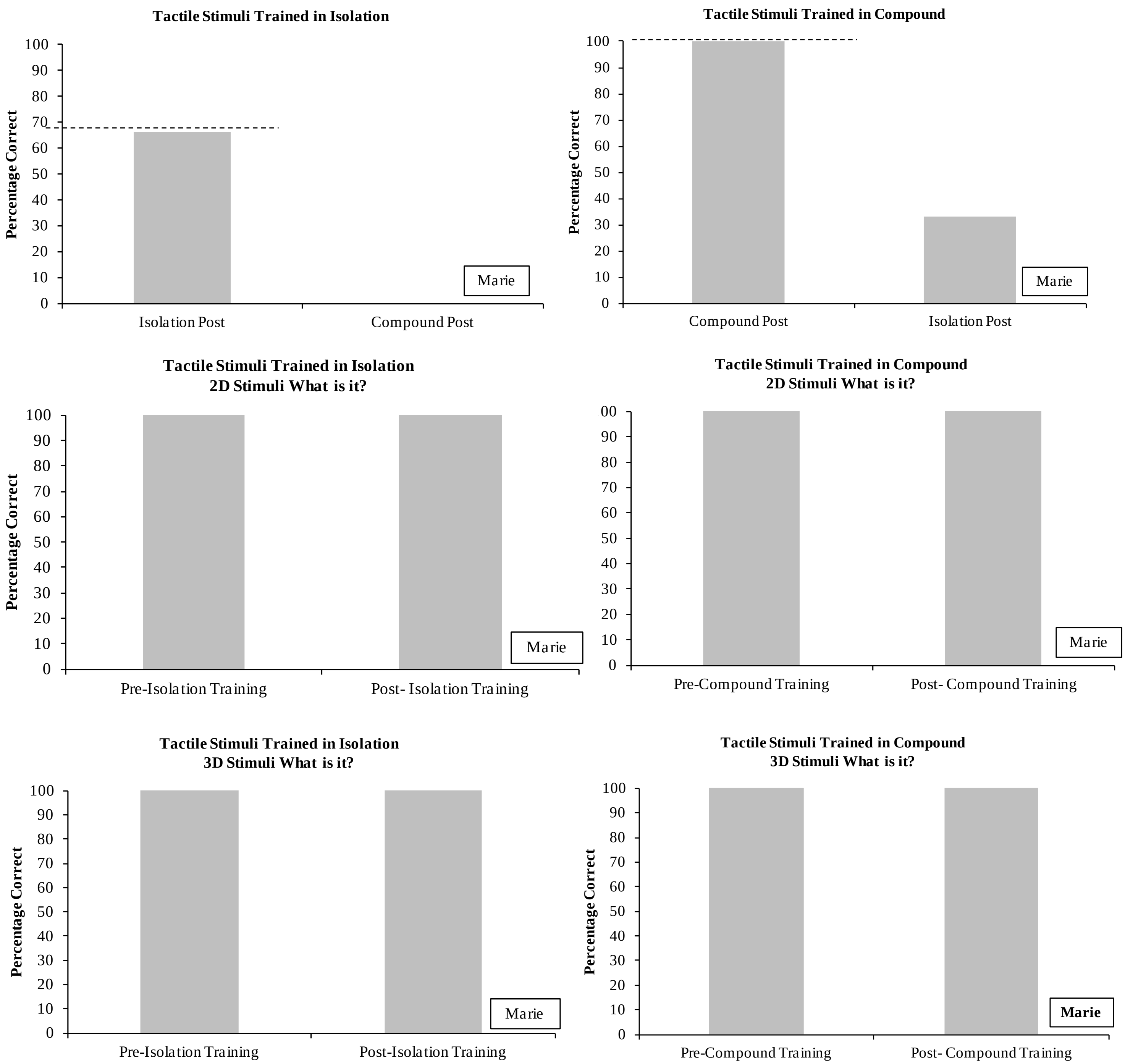


*Figure 3.* Follow-Up Probes for Tactile Tact Training: Marie (left: *Isolated*) (right: *Compound*)

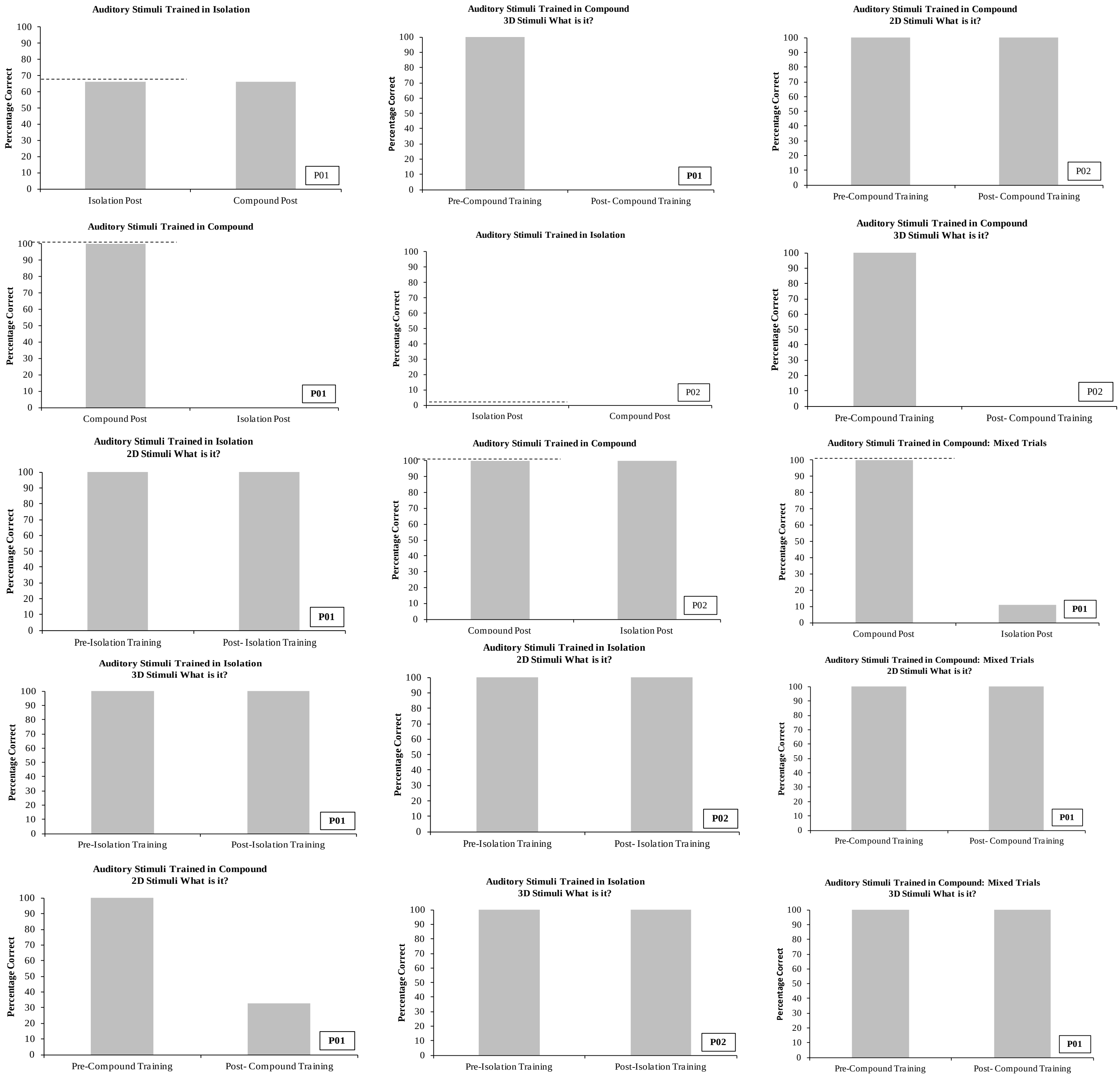


*Figure 4*. Follow-up Probes for Auditory Tact Training: From the left top panel to the middle top panel, Marie's results are listed for the Isolated and Compound conditions. From the middle second panel to the right second panel, Rose's results are listed for both conditions. From the right third panel to the last panel, Marie's results are listed for the Mixed Trials. *Note:* Dashed lines indicate the percentage correct reached during acquisition.