Establishment of Naming in Children With Autism Through Multiple Response-Exemplar Training

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In behavior analysis, naming is defined as an integration of speaker and listener behavior. After exposure to a tact, appropriate listener behavior can occur, and vice versa, without direct training. When a child is able to learn new word-object relations from observations of others' tacts both as speaker and listener, full naming has emerged. Naming consists of echoic, pure tact, impure tact, and listener responses. However, children with autism often fail to acquire the naming capability. The present study replicated the results of previous experiments that have emphasized the role of a multiple exemplar training that involves a rotation of the antecedents for the different response types that constitute naming. Further, the present study extended previous research by requiring the participants to echo the teacher's tacts of the sample stimulus during matching-to-sample training, before naming probes. Consistent with the notion that a rotation of training trials across point to, pure tact, and impure tact responses produces naming skills in children with autism, the results showed improved tacting and listener behavior following such training.

Keywords: naming, autism, language development, incidental learning, multiple response-exemplars

[Horne and Lowe (1996)](#) presented the naming theory as an extension to [Skinner's (1957)](#) theory of verbal behavior that emphasize the role of speaker and listener behavior within the individual. Further, they defined naming as "a higher order bidirectional behavioral relation that combines conventional speaker and listener functions so that the presence of either one presupposes the other" (p. 207). Thus, naming is a verbal capability, which is formed by tacting and listener responding emerged from previous exposure to the object and its corresponding name. [Horne and Lowe (1996)](#) suggested a test to determine whether a child has acquired the naming capability. The test involves training speaker responses to novel stimuli, and test for the corresponding listener responses and vice versa ([Fergus Lowe, Horne, Harris, & Randle, 2002](#); [Horne, Lowe, & Randle, 2004](#); [Kobari-Wright & Miguel, 2014](#); [Mahoney, Miguel, Ahearn, & Bell, 2011](#); [Miguel & Kobari-Wright, 2013](#)). In a slightly different definition proposed by [Greer and Ross (2008)](#), naming is considered as a verbal behavioral cusp. The cusp implies that children can learn the names of novel stimuli incidentally, merely from observation of others' tacts ([Greer & Du, 2014](#); [Rosales-Ruiz & Baer, 1997](#)). Greer and col-

leagues have called this full naming. After exposures to novel tacts, a test of full naming consists of probing the emergence of both speaker and listener responses (Greer & Longano, 2010; Greer & Ross, 2008). Thus, naming consists of a bidirectional relation between the listener (to point to or to orient to an object tacted by another person) and the speaker component (to emit tacts, either pure or impure, as explained in the next paragraph; Greer & Longano, 2010).

Children with a naming repertoire are able to emit listener and speaker behavior upon observing an adult's tact of an object or event (Carnerero & Pérez-González, 2014, 2015; Gilic & Greer, 2011; Horne & Lowe, 1996). For example, a caregiver seeing a swan on a lake can initiate joint attention by directing the child's attention toward the novel stimulus, the swan, and tact the stimulus. From an incidental experience, such as hearing the adult's tact "swan" in the presence of the swan, the child can emit corresponding listener behaviors, for instance pointing to the swan when asked to do so. Also, the child can respond with a pure tact as well as an impure tact, as when just upon seeing a swan saying "swan" (pure tact) or emitting "swan" in reply to the question "What is that?" (impure tact).

Naming is a critical verbal phenomenon in children's early language development. Considerable research suggests that the vocabulary of 2–3-year-olds expands exponentially when naming is established. The rapid emergence of new words in children's repertoire is often referred to as the verbal vocabulary "explosion" (Greer, Corwin, & Buttigieg, 2011; Greer & Longano, 2010; Hart & Risley, 1995; Horne & Lowe, 1996; McGuinness, 2004), and is assumed to consist of the emergence of naming. Before children learn to speak, they learn to listen (Horne & Lowe, 1996). The child learns listener responses through following other's pointing and tacting of objects in the environment. In turn, the child itself is pointing to objects that are discriminative for caregivers' tacting of stimuli during joint attention episodes. During listener training, the child learns to emit similar utterances as caregivers, repeating vocally what another just uttered. Such verbal behavior, called *echoic* has an important function, which is to transfer verbal stimuli into verbal responses (Palmer, 2014). As Greer and

Longano (2010) claimed, the echoic "appears to join the listener and speaker repertoires and may be . . . similar to what occurs with typically developing children as they learn names for things" (Greer & Longano, 2010, p. 88).

According to Catania (2013) "tacting is at the heart of naming, but tacting alone is not enough" (p. 319), and the echoic is also assumed to be a key in naming (Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005). Tact is a verbal operant under the control of nonverbal antecedents, such as when the child says "Mom" when she sees her. Both the tact and the echoic are maintained by socially conditioned reinforcers. Learning tacts involves the child echoing the tact response before being able to emit the response as a tact. In accordance with Horne and Lowe (1996) and Lowenkron (1988, 1989), Greer and Longano (2010) suggested that "naming is directly reinforced by the echoic product even if the echoic is covert" (p. 98). The echoic product as a reinforcer occurs when the child hear itself being able to produce similar utterances, similar to those produced by a caregiver, which increases the likelihood of such echoing in the future. However, Horne and Lowe (1996) have also point out that the caregivers have an important role in reinforcing echoic behavior. Then, after learning listener responses and echoics, children learn to tact stimuli (Horne & Lowe, 1996). Before the naming cusp is acquired, listener and speaker responses are independent repertoires (Greer & Longano, 2010; Miguel & Petursdottir, 2009). Horne and Lowe (1996) proposed a detailed explication of the acquisition of bidirectional naming. According to their interpretation, bidirectional naming appears initially through orienting responses when stimuli are tacted in the environment, and through self-echoic the listener responses are reinforced. That is, when a child is exposed to other tacts, such as "Get the doll," to act accordingly is probably socially reinforced in the presence of the doll. Simultaneously, the child is looking at the doll and will likely repeat the caregiver's tact of the stimulus, which is being reinforced by the caregiver. Several similar episodes involving a variety of stimuli, will create an interlocking set of speaker–listener relations. In the naming capability, the listener and speaker repertoires become joined or bidirectional. At this point, the establishment

of one of the components automatically produce both listener and speaker responses.

Greer, Stolfi, et al. (2005) summarized and emphasized that prerequisites for naming consist of at least three skills: First, listener behavior or the listener component of naming (Greer & Longano, 2010), looking for things and pointing based on what has been said. Second, echoic behavior, repeating names when they are spoken. Third, vocal tacting, saying the names given the objects. The two latter are considered as the speaker components of naming (Greer & Longano, 2010). Joint attention also plays a major role in the acquisition of naming skills (Horne & Lowe, 1996). In order to establish appropriate listener responses, the child must be able to respond to bids of joint attention, through well-established orienting or pointing responses toward an object that the caregiver is tacting. Likewise, tacting constitutes crucial skills in initiating joint attention. When a child simultaneously tacts a novel object and draws others' attention to the object in focus, it is likely to produce social reinforcers, such as others' nodding and smiling and comments about the object (Holth, 2010).

In fact, children with naming skills are able to learn novel verbal behavior through incidental experiences in natural settings, in an ordinary interaction between children and caregivers (Catania, 2013; Greer & Longano, 2010; Greer & Ross, 2008; Horne & Lowe, 1996; Miguel & Petursdottir, 2009). In such natural settings, however, children with autism tend to show a more limited learning outcome than typically developing children. Thus, children with autism often need comprehensive and highly structured teaching methods (Eikeseth & Klintwall, 2013; Greer et al., 2011; Smith, 2001). In addition, these children tend to fail to respond to caregiver's attempt to teach verbal behavior incidentally (Spradlin & Brady, 1999). On the other hand, children with autism, as well as typically developing children, who have acquired the naming cusp learn new words incidentally, both as speaker and listener without requiring explicit teaching or reinforcement (Greer & Longano, 2010; Greer & Ross, 2008; Greer, Stolfi, & Pistoljevic, 2007; Pistoljevic, 2008). Furthermore, Greer and Ross (2008) claimed that "the capability of naming increases the child's learning capacity threefold" (p. 151), and the acquisition of naming is a predictor of success when

students start school (Greer et al., 2011). Greer et al. (2011) proposed that onset of naming makes it possible for children to learn in typical educational settings, where they could not prior to acquisition of such skills. To establish naming in children who lack those skills can provide both additional incidental learning experiences and expand a child's academic, social, and problem-solving skills (Greer & Ross, 2008).

Hayes, Barnes-Holmes, and Roche (2001) suggested that emergent relations are "shaped through contingencies involving multiple exemplars" (p. 148). A history of multiple exemplars could induce generalized operants, such as the higher-order naming relation described by Horne and Lowe (1996). Horne and Lowe (1996) highlighted that the higher-order name relation only will function as emergent responding after it has repeatedly been reinforced, with respect to a range of novel objects (i.e., multiple exemplars). Furthermore, Hayes et al. (2001) suggested that multiple exemplar training (MET) offers a child a history of reinforcement for relating different stimuli in a number of ways. Thus, MET is a teaching method that involves "directly teaching a specific behavior with a variety of stimulus variations or response topographies that ultimately helps to ensure a learner acquires a desired response in the form of multiple untrained topographies" (Rosales, Rehfeldt, & Lovett, 2011, p. 61). One type of MET involves the rotation of both teaching stimuli and antecedents that produce different response types (e.g., Greer et al., 2007). Thus, this type of MET for the establishment of naming comprises the rotating of different response classes controlled by the same stimulus, and is therefore more properly called multiple response-exemplar training (MRET). The purpose of MRET is to join multiple responses to stimuli to promote different types of stimulus control into an higher-order operant (Greer & Speckman, 2009). Such training has been proposed as being both necessary and sufficient to establish naming (e.g., Greer & Ross, 2008).

Several experiments have shown the effectiveness of MRET with rotation of the antecedents for the different response types that constitute naming in building such skills in children with autism (e.g., Fiorile & Greer, 2007; Greer et al., 2011; Greer & Du, 2014; Hawkins, Kingsdorf, Charnock, Szabo, & Gautreaux, 2009; Longano, 2008), in children with pervasive de-

velopment disorder (Greer, Stolfi, et al., 2005), in children with language delay (Greer, Stolfi, et al., 2005; Greer et al., 2007; Pistoljevic, 2008), and in children with developmental delays (Greer, Stolfi, et al., 2005; Greer et al., 2007; Woolslayer, 2013) as well as in typically developing children (Gilic & Greer, 2011; Greer et al., 2011; Greer & Du, 2014).

The importance of MRET in the establishment of naming skills was strongly suggested by a study in which participants exposed to MRET training demonstrated the acquisition of naming, but those exposed only to single response-exemplar training did not, until after MRET was subsequently introduced (Greer et al., 2007). Single response-exemplar training included no rotation between listener and speaker responses. Rather, the response classes included in naming were taught separately. The teachers first gave instruction separately on match responses, then listener responses in separate sessions, followed by pure tact sessions and, finally, impure tact sessions. For comparison with the MRET group, the single response-exemplar group was yoked to the MRET group with respect to the number of trials, or learn units.

Furthermore, research has showed that naming can be induced in preschoolers who did not have the listener to speaker component of naming prior to MRET (Greer, Stolfi, et al., 2005), and in those who neither had the speaker-to-listener or the listener-to-speaker repertoire (Fiorile & Greer, 2007). Based on their literature review, Petursdottir and Carr (2011) suggested that teaching speaker responses prior to listener responses are slightly more efficient than the opposite training sequence.

Greer, Stolfi, et al. (2005) described an example of a study where MRET has produced a promising outcome regarding the emergence of the speaker component of naming skills in three preschoolers with language delay or developmental delays. They probed naming skills prior to and after MRET. During the pretraining phase with matching to sample (MTS), the teacher tacted the sample stimulus before the probing of naming. Following the completion of one teaching set with MRET, naming probes first tested listener responses, then pure tacts and, finally, impure tact responses. The final naming test with unfamiliar stimuli showed that untaught speaker responses emerged.

The main purpose of the present study was to replicate and extend previous research on derived relational responding by using MRET with rotation of constituent trial types to establish naming. Our protocol was similar to the one employed by Greer and colleagues (Greer & Longano, 2010; Greer & Ross, 2008; Greer, Stolfi, et al., 2005; Longano, 2008). To avoid a potential effect of the child echoing the adult's vocal tact during the testing of tacts, we changed the test sequence so that listener responses were tested only after the probing of pure and impure tacts. A second purpose was to investigate whether the requirement of echoing the names of the novel stimuli during MTS would strengthen the listener responses during naming probes, as implied by Horne and Lowe's (1996) suggestion that the echoic is a key to the establishment of naming skills.

Method

Participants

Three preschool children, aged 4 to 6, participated in the study. All participants were diagnosed with autism or atypical autism, according to International Statistical Classification of Diseases and Related Health Problems–10 (World Health Organization, 2008). The participants attended public funded kindergartens, and received early intensive behavioral intervention (EIBI), except for one child. In order to assess the participants' language abilities we administered The Assessment of Language and Learning Skills, Revised (ABLLS-R; Partington, 2006) 3 to 6 months prior to the present study. All participants were also tested with Vineland Adaptive Behavior Scales–Revised (Sparrow, Balla, & Cicchetti, 1984). A summary of the description of the participants is shown in Table 1.

The participants were recruited by the special services based on the inclusion criteria described as prerequisites for naming by Greer, Stolfi, et al. (2005). The criteria for participation in the study were (a) the mastery of MTS and echoic skills at a generalized level; (b) compliance skills, such as being able to sit at a table and follow instructions for at least 2 min before breaks; (c) demonstration of at least 15–20 listener responses (i.e., receptive identification of objects, actions, name of family members, or feature of objects); (d) exhibition of

Table 1

Summary of the Description of the Participants According to Age, Diagnosis, Standard Vineland Scores and ABLLS-R Scores, and Verbal Description

Participant age diagnosis	Standardized test scores	Verbal description
David	VABS-R	− Speaks in sentences up to 5–6 words
	− Socialization: 88	− Listener: nonverbal imitation, one to two steps
four years and four months old	− Communication: 102	directions, over 50 pointing-to as response to listener, matching to sample, looks at books
	− Composite: 75	appropriately
Childhood autism	ABLLS-R	
	− Receptive language (C): 79%	− Speakers: echoics in natural settings multiple pure mand, and tact by using sentences, verbal
	− Vocal imitation (E): 86%	imitation
	− Requests (F): 43%	− Listener/speaker: one turn conversation
	− Labeling (G): 40%	
	− Intraverbals (H): 14%	
	− Spontaneous vocalization (I): 96%	
	− Syntax and grammar (J): 18%	
Nina	VABS-R	− Speaks in sentences up to 6–8 words
	− Socialization: 79	− Listener: nonverbal imitation, two steps
five years and five months old	− Communication: 76	directions, matching-to-sample, over 50 pointing-to as response to listener, looks and
	− Composite: 76	point in books when reading for
Atypical autism	ABLLS-R	
	− Receptive language (C): 98%	− Speakers: Vocal imitation, multiple pure
	− Vocal imitation: (E) 89%	mands, and tacts by using sentences, some play-language
	− Requests (F): 81%	− Listener/speaker: one to two-turn conversations
	− Labeling (G): 64%	
	− Intraverbals (H): 31%	
	− Spontaneous vocalization (I): 93%	
	− Syntax and grammar (J): 46%	
Tom	VABS-R	− Speaks in sentences up to 2–3 words.
	− Socialization: 61	− Listener: nonverbal imitation up to 74% (D)
four years and eight months old	− Communication: 65	and mastered up three steps direction, mastered matching-to-sample up to a generalized level.
	− Composite: 63	Over 50 pointing-to as listener, looks and points in books when read to
Childhood autism	ABLLS-R	− Speakers: Vocal imitation of simple sounds and
	− Receptive language (C): 44%	words at a generalized level, but some words
	− Vocal imitation (E): 32%	with poor pronunciation, multiple pure mands
	− Requests (F): 29%	with simple words, and tacts up to two words
	− Labeling (G): 14,2%	sentences, some play-language
	− Intraverbals (H): 8,7%	− Listener/speaker: one turn conversation. He
	− Spontaneous vocalization (I): 85%	answered some simple basic questions about
	− Syntax and grammar (J): 16%	his family

Note. Assessment of Basic Language and Learning Skills, Revised, is summarized as percent achievement per skills areas at intake in the study. VABS-R = Vineland Adaptive Behavior Scales-Revised; ABLLS-R = Assessment of Basic Language and Learning Skills-Revised.

at least 15–20 impure tacts (i.e., expressive labeling of objects with the verbal antecedent "What is this?" in addition to nonverbal stimuli); and (e) demonstration of 15–20 pure tacts (i.e., a labeling of nonverbal stimuli without any verbal antecedents). The experimenters did not know the children before their participation in the study. Before gathering informed consent from the caregivers, the Norwegian Social Science Data Services approved the current study.

David was four years and four months old and received approximately 25–30 hr of EIBI.

He scored high at cooperation and reinforcer effectiveness according to ABLLS-R, and a token economy system with 20 tokens was established prior to the current study. His language abilities scored from ABLLS-R showed far above the inclusion criteria for this study (see Table 1). David was used to receiving instruction for 10–15 min with short breaks, and was familiar with intervention according to discrete-trial teaching both in a one-to-one teaching format and in small groups.

Each trial of discrete-trial teaching involves (a) a clear and discrete presentation of the task, (b) a described prompting procedure, (c) immediate reinforcement of correct response, (d) use of behavior-specific praise, (e) consistent time interval between each trial, (f) ensuring the child's attention before the task and the antecedent are presented, (g) data collection by trial-by-trial recoding, and (h) the verbal antecedent is appropriate in accord to the task (Eikeseth, Smith, & Klintwall, 2014; Ghezzi, 2007; Lovaas, 2002; McKenney & Bristol, 2015).

Nina was five years and five months old and received approximately 25–30 hr of EIBI per week. She scored high on cooperation and reinforcer effectiveness measured by the ABLLS-R. Nina had met all the inclusion criteria in all areas that are considered as prerequisites for the establishment of naming (see Table 1). She was familiar with discrete-trial teaching, both individually and in a preschool group in the kindergarten.

Tom was four years and eight months old and did not receive any individualized instruction when the study began. However, he was on the waiting list for EIBI. Meanwhile, he was included in a special education group in the kindergarten. He had no previous experiences of being in an instructional setting such as being instructed to sit by a table and attend to teacher-presented materials for 2 to 5 min. Tom was included even though his performances did not strictly meet all of the criteria: He had not yet learned to return preferred toys when instruction continued (see Table 1), and is cooperation depended on short sessions, both on the floor and at the table, and also on the consistent and frequent use of effective reinforcers.

Setting

All training and testing was conducted in the children's kindergartens, by two adults, one teacher, and one observer. The observer collected the data and video-recorded the sessions. All test sessions and almost all training sessions were videotaped, for later reliability tests. The staff in the kindergarten received supervision on EIBI from the special services in the county but was not otherwise trained in behavior analysis. The children received teaching as usual, but the stimuli included in this investigation were not otherwise targeted during the time of the study. Two hr of training daily for 8 days were spent with David and Nina to complete teaching, probing, and data collection. With Tom, we used 2 hr three times per week in 2 months to complete the study. Each of the participants had their teaching room with tables and chairs, shelves with training materials, and a box of toys with potential reinforcing effect. The researchers brought a small suitcase of toys that the participant could choose to play with during breaks. In addition, Tom could also choose to play with an iPad with games and cartoons appropriate for children.

Definition of Naming Skills

The untaught responses scored as naming skills were (a) pure tacts, (b) impure tacts, and (d) point-to relevant objects from solely having observed the objects being tacted by the adult. Echoing was considered a prerequisite skill.

Materials

The stimulus material consisted five pictures of objects from each of five different categories. The pictures were 5 cm × 7 cm, and the stimuli in the pictures were unfamiliar to the children, which implied that they neither tacted nor displayed a conventional response to "point-to" instructions. The stimuli identified as novel for the participants are shown in Table 2. During breaks, we offered a diversity of toys to play with, such as puzzles.

Design

A nonconcurrent multiple-probe design across three individual participants was used (Watson & Workman, 1981). Untaught responses were probed before and after each of the two training conditions. The participants began and completed the experimental sequence independently of one another (Morgan

Table 2
Overview of Stimuli and Experimental Sequence

Participants	Pre- and Posttests	MRET	Pre- and posttests	MRET	Final test
David	Set 1 Birds	Set 2 Animals	Set 3 Flowers	Set 4 Attractions in Bergen	Set 5 Flags
	Parakeet	Lama	Tulip	Fløibanen	Flag of Denmark
	Puffins	Badger	Daffodil	Ulriken	Flag of Finland
	Grouse	Weasel	Snowdrop	Grieghallen	Flag of Greece
	Tit	Raccoon	Hepatica	Gamlehaugen	Flag of Spain
	Wagtail	Goat	Buttercup	Bryggen	Flag of Italy
Nina	Set 1 Flowers	Set 2 Attractions in Bergen	Set 3 Birds	Set 4 Flags	Set 5 Animals
	Tulip	Fløibanen	Parakeet	Flag of Denmark	Otters
	Daffodil	Ulriken	Puffins	Flag of Finland	Badger
	Snowdrop	Grieghallen	Peacock	Flag of Greece	Weasel
	Bluebell	Gamlehaugen	Wagtail	Flag of Spain	Raccoon
	Forget-me-not	Bryggen	Grouse	Flag of Italy	Koala
Tom	Set 1 Animals	Set 2 Fruits	Set 3 Birds	Set 4 Tools	Set 5 School things
	Leopard	Pineapple	Bullfinch	Kelp	Eraser
	Rhino	Melon	Flamingo	Wrench	Lunch box
	Wolf	Coconut	Cockatoos	Planer	Crayons
	Badger	Kiwi	Duck	Screwdriver	Pencil
	Panda	Peach	Peacock	Drill	Sharpener

Note. MRET = Multiple response-exemplar training.

& Morgan, 2009). The design included pre- and postprobes of naming that were untaught response topographies. Treatment, however, was delayed for each successive participant in a time-lagged fashion (Barlow, Hersen, & Nock, 2009), because of the increased length of the baseline under extinction conditions required for each child. Thus, controlling for maturation and instructional history implies a genuine experimental design. Barlow et al. (2009) suggested noncurrent multiple baseline designs as a particularly useful design in applied settings when a more strict design may not be appropriate, and the design allows for more flexibility. This flexibility, of using a design with elements that are temporally concurrent, allows applied researchers to assign the participant to various baseline lengths as they are naturally referred (Watson & Workman, 1981).

Data Collection

The data were collected trial-by-trial throughout the entire study. Each trial was scored either as correct or incorrect. To be scored as correct, the response had to occur without prompts and within approximately 6 s following the presentation of the task. All sessions, such as pre- and postprobes of naming, pretraining before probing of naming and, finally, MRET sessions were 20-trial sessions, and all data were scored as the number of correct responses per session.

Reliability

Interobserver agreement (IOA; Cooper, Heron, & Heward, 2007) was calculated for the three participants in the randomly selected probe and intervention sessions from all phases and was calculated by dividing agreement with total trials checked multiplied by 100. Three independent observers scored videotaped trials, and IOA was calculated for 47% of all sessions. Mean IOA on these trials was 98% across the three participants.

Treatment Fidelity

Treatment fidelity was estimated in five randomly selected sessions for each of the participants. The fidelity check evaluated whether (a) both the stimuli and the antecedents were rotated across trials according to the

MRET protocol, (b) naming probes were conducted under extinction conditions, (c) no inadvertent verbal stimuli were present during pure tact test trials, (d) correct prompting procedures were used, and (e) the mastery criterion was followed for each participant independently. The criterion for the achievement of the treatment fidelity was 90% according to the intervention protocol. The treatment fidelity check showed an accuracy of 100% for David and Nina and 93% for Tom.

Procedure

A general overview of the procedure, with brief descriptions of all phases in the experiment, is shown in Table 3.

Preexperimental test. The objective of the preexperimental tests was to identify five novel stimuli in each of the five different categories.

Table 3
Experimental Sequence

Phase #	Description of the phases
Phase 1	Pre-experimental identification of novel stimuli, five sets of five pictures
Phase 2	Pretraining of Matching-to-sample with adult tacts while the participants echoic with Set 1 pictures
Phase 3	Prenaming probes of untaught speaker and listener responses with Set 1 pictures
Phase 4	Multiple Response-Exemplar Training across four response types with Set 2 pictures
Phase 5	Pretraining of matching-to-sample with adult's tacts and the participant's echoic with Set 1 pictures
Phase 6	Postnaming probes of untaught speaker and listener responses with Set 1 pictures
Phase 7	Pretraining of matching-to-sample with adult's tacts and the participant's echoic with Set 3 pictures
Phase 8	Prenaming probes of untaught speaker and listener responses with Set 3 pictures
Phase 9	Multiple Response-Exemplar Training across four response types with Set 4 pictures
Phase 10	Pretraining of matching-to-sample with adult's tacts and the participant's echoic with Set 3 pictures
Phase 11	Postnaming probes of untaught speaker and listener responses with Set 3 pictures
Phase 12	Pretraining of Matching-to-sample with adult's tacts and the participant's echoics with Set 5 pictures
Phase 13	Final naming probes of untaught speaker and listener responses with Set 5 pictures

Probes were conducted prior to the experiment to ensure that the participants did not already master listener and speaker responses relevant to pictures of objects in the categories. Preexperimental tests were conducted in the following order: First matching of identical stimuli. The vocal antecedent "Find the same," rather than the tact, was used in the instruction in order to avoid that the child would echo the names later in the test. Second, pure tacts were tested. The experimenter presented the picture at the table without any vocal antecedent. Third, impure tacts were probed. The experimenter presented the picture and asked "What is this?" Fourth, listener responses were tested. An adult asked the child to point to a target stimulus and the participant had a choice between one comparison picture that corresponded with the sample, and four incorrect comparison pictures. Each stimulus was tested three times. If the child responded incorrectly or did not provide a response in accord with the instruction within approximately 6 s, the responses were scored as incorrect, and the experimenter moved on to the next stimulus.

The inclusion criterion for novel stimuli in the present study was that, in a sequence of three trials, the child displayed no correct speaker responses, maximum one correct of each of the listener responses and, finally, at least 90% mastery of the MTS tasks with the five stimuli in each category. If a child responded correctly in the presence of a stimulus once during testing of pure or impure tacts, the stimulus was excluded from the set and replaced by a new stimulus.

However, when testing listener responses, we considered a correct response once as potentially accidental, but if the child mastered two listener responses to the same stimulus, the stimulus was excluded. One important issue was that in order to hinder that a listener response prompted later tacts, participants were not given the opportunity to hear the tact until during the listener responses were probed. The sequences of the stimulus sets were randomly drawn for naming probes and MRET and varied across participants. Table 2 shows the five novel stimuli identified in the five sets. After identification of novel stimuli, baseline probes of naming were conducted.

Probes of naming. During the baseline probes, we tested the presence or absence of

naming. As pretraining before baseline probes, all participants were taught to echo while matching the adult's tacts of the target stimuli in Sets 1, 3, and 5.

Matching-to-sample and echoic instructions. The pretraining of echoics in MTS tasks was the condition that allowed the children to listen to the novel names of the stimuli prior to naming probes. The setting was an approximation to natural conditions where children can hear novel stimuli being tacted. In the MTS tasks, all five comparisons were presented on the table, and then the visual sample stimulus was presented along with the adult's tact of the stimulus. An accurate MTS response consisted of the child putting a visual sample stimulus on top of the corresponding comparison stimulus while simultaneously exhibiting correct echoing of the adult's vocal tact of the stimulus. The matching-to-sample response had to occur within approximately 6 s after the verbal antecedent of the adult's tact of the stimulus. The stimuli were rotated on the table between trials. While the echoic responses ensured that the participants heard the vocal tacts of the stimuli, the MTS tasks required that the participants' responding was controlled by the visual stimuli. All MTS-task sessions consisted of 20 trials. Throughout all training sessions (MTS and MRET), the mastery criterion was set to 90% or better in two consecutive sessions, or one session with 100% correct responding.

Probes of novel speaker and listener responses. Each of the three response types defined as naming were tested separately under extinction conditions. The fourth response type included in naming, echoing, was a prerequisite and therefore not tested during naming probes. First, pure tact responses were probed by presenting the visual stimuli on the table in front of the child for approximately 6 s. For example, the teacher placed a picture of a papaya on the table, and the child responded by saying "papaya." Then, the impure tact responses were probed by presenting a picture along with the vocal antecedent "What is this?" For example, the participant uttered "coconut" following the presentation of a picture of a coconut and the experimenter's vocal antecedent "What is this?" Finally, the listener responses consisted of the child pointing to the target stimulus presented on the table with four nonexemplars and the verbal antecedent "Point to _____." For example,

a picture of a pineapple, a peach, a coconut, a melon, and a kiwi were placed at the table. Responses that were not in accord with the antecedent tact were considered as incorrect.

Probe sessions consisted of 60 trials without the differential reinforcement of correct responses. That is, 20 pure tacts, 20 impure tacts, and 20 listener responses. However, to maintain responding, the participants were given a verbal feedback, such as "ok," "yes," "excellent," "good," "aha," "mm," whether the response was correct or incorrect. In addition, every third to fifth trial was a maintenance task interspersed between test trials. The maintenance tasks were questions regarding names of known objects or family members, or the children were asked to point to body parts or objects in the room. Correct responses were followed by the delivery of tangible reinforcers. The naming test was considered as positive if the child responded correctly on at least 70% of the naming probes.

Multiple response-exemplar training (MRET). The MRET procedure consisted of randomly rotated stimuli and antecedents aimed to produce the different response classes with respect to the five unfamiliar stimuli in each set. The response classes were MTS with the prerequisite echoics, as well as pure tacts, impure tacts, and point-to responses. MRET was used with Stimulus Sets 2 and 4. Before and following teaching according to MRET, we presented the naming probes, as described above.

The trials were rotated across response exemplars, and the visual stimuli were rotated accordingly. That is, the child matched the first stimulus in the set; then we taught a pure vocal tact in the presence of the second stimulus, an impure tact in the presence of the third stimulus, and a point-to response to the fourth stimulus in the set. In the presence of the fifth stimulus in the training set, the child was again exposed to a matching-to-sample trial, and thereby imposed a rotation among the stimuli included in the set. Therefore, the next presented stimulus was the first stimulus presented in the previous sequence; the stimulus presented to a matching trial in previous sequence was this time exposed to a pure tact trial, then impure tact trial, and so on. The remaining visual stimuli and response exemplars were rotated over the subsequent trials. This pattern continued until all five stimuli have been presented four times each, and the session was completed with 20 trials.

In all instructional sessions (both MTS with echoic, and MRET), we used discrete-trial teaching. Conditioned reinforcers, for example, praise, smile, token, and doing "high five," reinforced each correct response. The participants were given a play break of at least 5 min duration before probes of naming were run. In sum, instructional sessions were run as either pretraining before probing of naming and consisted of MTS with adult's tact of the sample stimuli, or in accordance with MRET with rotation of the trial types.

Prompting Procedure During Instructional Sessions

If the child emitted an incorrect response or no response to the visual and vocal antecedents within approximately 6 s, the same trial type was repeated with a prompt in the subsequent trial. For example, during MTS with echoic, the teacher pointed to the correct picture or gave a verbal prompt, such as "Say after me, [name of the stimulus]" or "Your turn" after tacting the stimulus. All prompts were faded until the mastery criterion was met, prior to the naming probes. When teaching pure and impure tact responses during MRET, we used vocal prompts, and when teaching listener responses, we used either a position or a pointing prompt. After a prompted trial, the same trial type was repeated in order to give the child the opportunity to respond in the absence of an immediately antecedent prompt.

Results

In all MTS phases, the performance of David, Nina, and Tom met the mastery criterion after one to three 20-trial sessions, and all four response classes that were included in MRET were mastered in three to 27 sessions. All participants showed improved naming skills after the MRET was completed. Finally, untaught speaker and listener responses were established, after exposure only to the teacher uttering the name of the stimuli during MTS tasks.

During Phase 1, the preexperimental identification of novel stimuli, the results indicate that the stimuli were unfamiliar to the participants prior to the study. Although all participants displayed excellent matching skills with the verbal antecedent "Find the same," they showed no

tacts, neither pure nor impure. During testing of pure and impure tacts, the participants either uttered the category name (i.e., "Flower") for all stimuli in the sets, the appropriate color name, just answered "I don't know," or did not respond with any vocal responses. During testing of listener responses (i.e., point to), the children could respond correctly to some stimuli by chance. Five stimuli in the five categories or sets were identified. Echoic responses were tested with ABBLS-R. For all participants, the scores showed generalized echoing of simple words. The results of the preexperimental test showed generalized matching-to sample skills, but none pure and impure tact responses to the novel stimuli. However, all participants responded randomly as listeners to the novel stimuli. Out of the 25 stimuli presented three times, the participants emitted from four to seven correct listener responses, and the correct responses were never repeated to the same stimulus.

Figure 1 shows the percentage of correct trials during each session throughout all training phases, while Figure 2 displays the number of correct naming-probe trials across response classes, after simply being exposed to MTS with echoic of adult's tacts. During the subsequent naming probes, untaught speaker and listener responses were scored. The first probe set of stimuli was considered as baseline probes.

During Phase 2, the pretraining of matching-to-sample with the child's echoic of the adult's vocal tact responses, the data showed that David mastered MTS with echoic after three sessions during Set 1 stimuli, and Nina and Tom achieved MTS with echoic after two sessions.

During Phase 3, prenaming probes (baseline) of untaught speaker and listener responses (Set 1 stimuli), David showed no tact responses or impure tact responses. However, he displayed appropriate listener responses during 13 out of 20 trials (65%), which was just below the mastery criterion of 70% correct responses. Nina showed correct listener responses in 19 out of 20 trials (95%). Furthermore, Nina emitted eight pure tact responses (40%) and three impure tact responses (15%) out of 20 possible trials. Under baseline conditions, Nina was considered to have the capability of the listener component of naming, but not the speaker components. Tom emitted one pure tact response in 20 trials, no impure tact responses, and finally
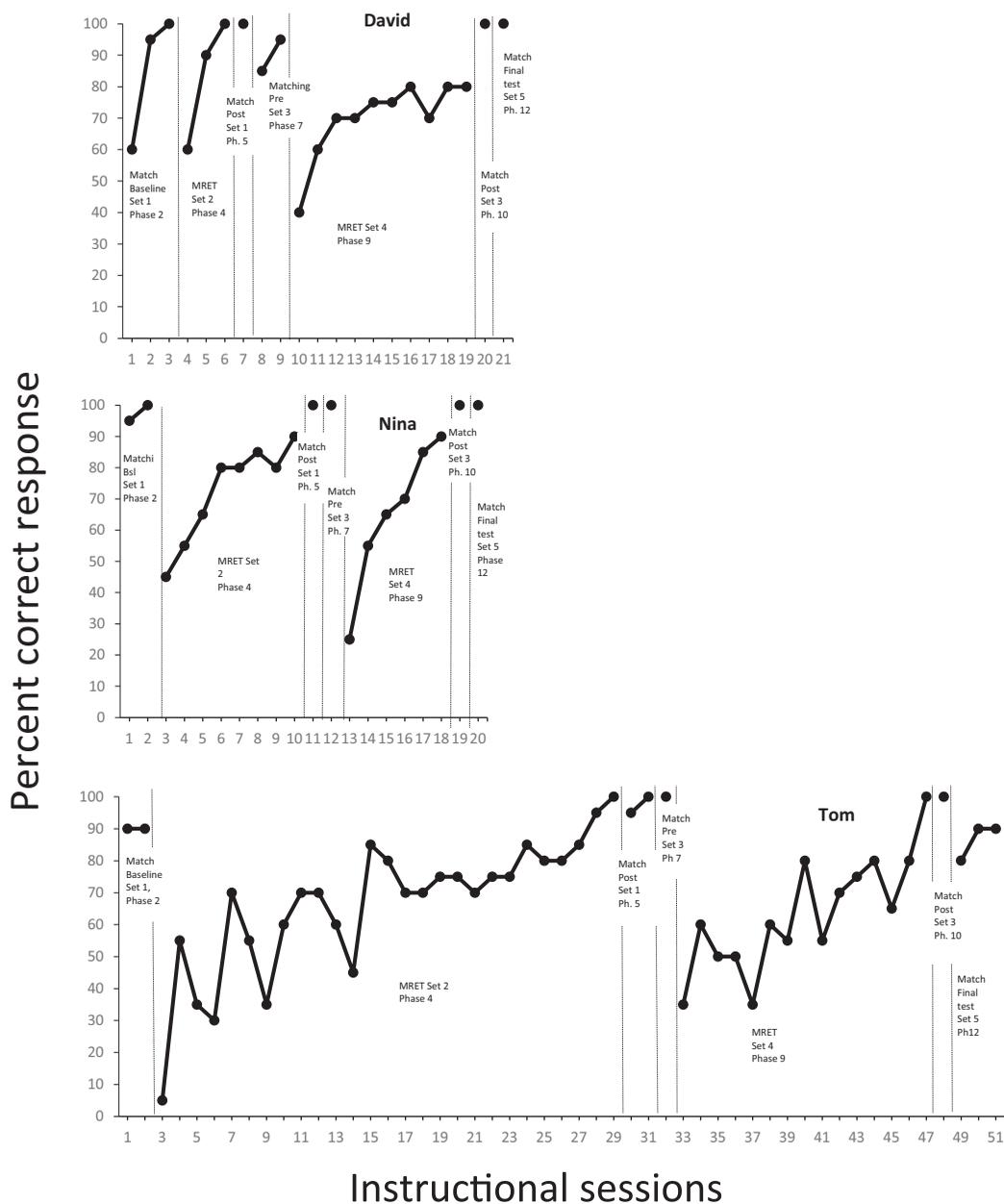
Figure 1. Percentage of correct responses during training sessions for David, Nina, and Tom are presented: (a) during Phase 2, matching-to-sample tasks with echoic of adult's tacts for Set 1 stimuli prior to the baseline probes; (b) during Phase 4, first block with MRET for Set 2 across pure tacts, impure tacts, and listener responses; (c) Phase 5, teaching them MTS with echoic of adult's tacts for Set 1 stimuli prior to the second naming probe, post MRET probes; (d) Phase 7, teaching MTS with echoic of adult's tacts, pretraining with Set 3 stimuli, prior to the third naming probes; (e) Phase 9, the second block with MRET with Set 4 pictures; (f) during Phase 10, MTS with echoic of adult's tact to Set 3 stimuli, pretraining before the fourth postnaming probes, and finally; (g) during Phase 11, MTS with echoic of adult's tacts to Set 5 stimuli prior to the final and fifth naming probe. These data are measures of the MTS condition included in the pretraining and the independent variable that was mastery of MRET conditions (Set 2 and 4) which consisted of reinforced trials. Ph. = phase; MTS = matching-to-sample; MRET = multiple response-exemplar training.
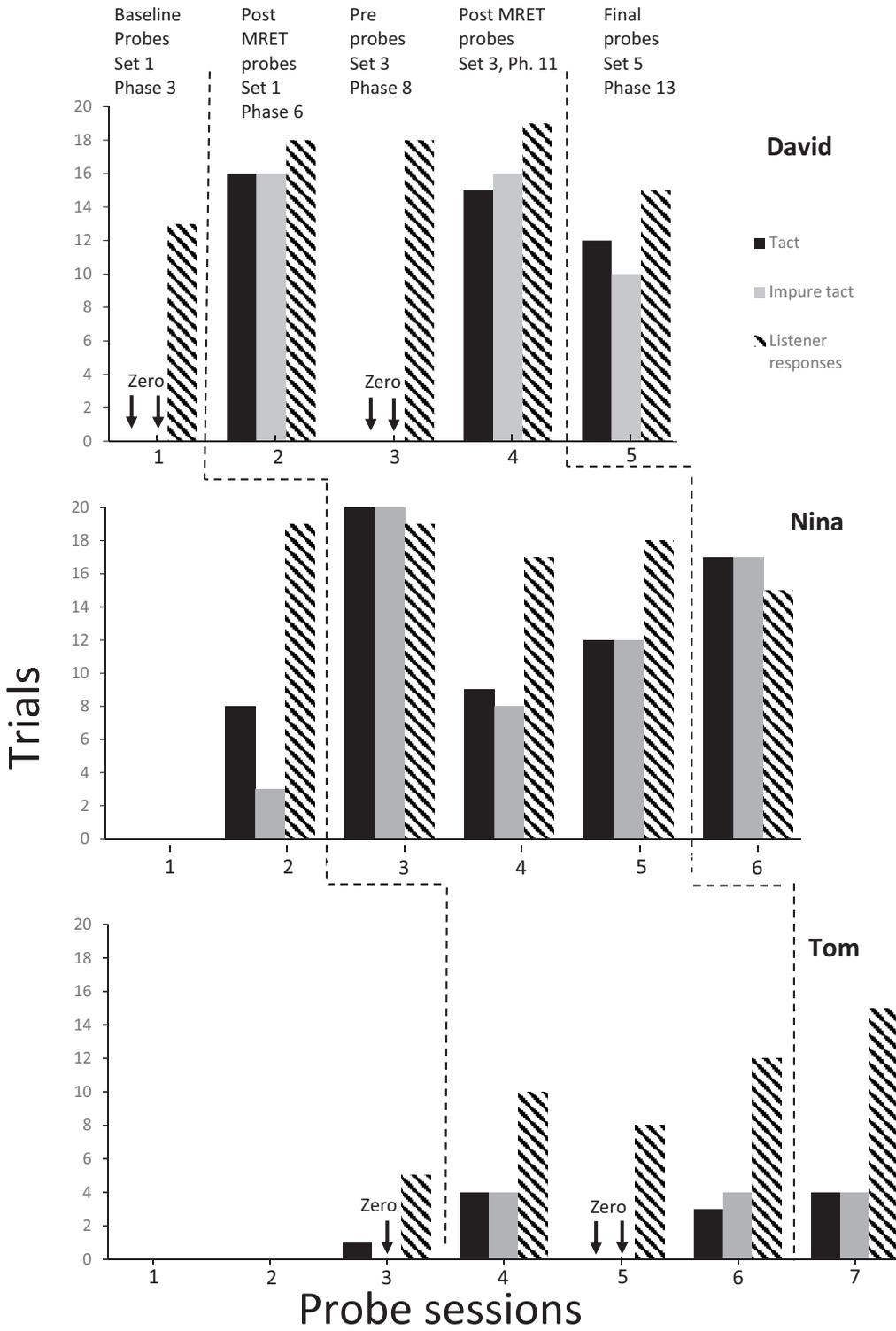
Figure 2 (opposite).

five correct listener responses during baseline probes with Set 1 stimuli.

During Phase 4, MRET across the four response classes (Set 2 stimuli), David mastered the classes included in the training after three 20-trial sessions, Nina mastered all four response classes after eight sessions. Tom met the mastery criterion for MRET sessions after 27 sessions.

During Phase 5, pretraining of MTS with the adult's tacts and the participants' echoic with Set 1 stimuli, David and Nina mastered MTS with echoic immediately, and Tom in the second session.

During Phase 6, postnaming probes of untaught speaker and listener responses to Set 1 stimuli, following MRET on a different set of stimuli (Set 2), David emitted correct untaught pure and impure tact responses in 16 out of 20 trials. Moreover, David displayed 18 out of 20 possible correct untaught listener responses. All of these numbers meet the mastery criterion for naming skills. Under the post naming probes of Set 1 stimuli, Nina responded correctly to 20 of 20 trials under tact and impure tact conditions (100%), and 19 out of 20 possible correct listener responses (95%). Finally, Tom had acquired four pure and impure tact responses, and 10 out 20 possible listener responses (50%).

During Phase 7, pretraining of MTS with adult's tact and the participant's echoic with Set 3 stimuli, David mastered MTS with echoic after two sessions, while Nina and Tom mastered MTS with echoic in the first session.

During Phase 8, prenaming probes of untaught speaker and listener responses to Set 3 stimuli were presented prior to the second set of MRET. David did not master pure and impure tacting skills to the novel stimuli. However, he demonstrated 18 out of 20 untaught listener responses. Nina emitted nine correct pure tact responses, eight impure tact responses and, finally, 17 untaught listener responses out of 20

possible. Tom did not master pure or impure tacting skills. However, he emitted eight untaught listener responses, after only hearing the names of the stimuli during MTS with adult's tacts.

During Phase 9, MRET, David mastered the four response types included in the training after ten 20-trial sessions with Set 4 stimuli, whereas Nina mastered the MRET in six sessions. Finally, Tom reached the mastery criterion after 15 sessions.

During Phase 10, pretraining of MTS with adult's tacts and the participants' echoic with Set 3 stimuli, all participants mastered MTS with echoic of the adult's tacts immediately.

During Phase 11, postnaming probes of untaught speaker and listener responses to Set 3 stimuli, David had established 15 pure tact responses (75%), 16 impure tact responses, (80%), and 19 listener responses out of 20 (95%). His achievements from postprobes of Set 1 stimuli were maintained after the second teaching set with MRET (Set 4). On the postprobes of Set 3 stimuli, Nina's rate of correct pure and impure tact responses decreased from 20 of 20 (100%) under tact and impure tact conditions to 12 out of 20 (60%). Following the MRET with Set 4 stimuli and hearing the names of the novel stimuli during MTS with the adult's tacting of Set 3 stimuli, Tom demonstrated three untaught pure tact responses and four impure tact responses, and he emitted 12 out of 20 possible untaught correct listener responses (60%).

During Phase 12, pretraining of MTS with the participant's echoic of the adult's tacts of Set 5 stimuli, David and Nina mastered the tasks immediately and, finally, Tom after three sessions.

During Phase 13, final-naming probes of untaught speaker and listener responses to Set 5 stimuli, the data for David showed that the percentage of trials with correct naming re-

Figure 2 (*opposite*). Established naming skills during five naming probes. The naming skills consist of untaught speaker responses; impure vocal tact skill and impure vocal tact skills and untaught listener responses in David, Nina, and Tom. The naming probes are (a) Phase 3, baseline-probe of Set 1 stimuli; (b) Phase 6, postprobes on Set 1 pictures, after MRET of Set 2 pictures; (c) Phase 8, preprobes of Set 3 stimuli; (d) Phase 8, postprobes on Set 3 stimuli, after second block MRET with Set 4 pictures; and finally, (e) number of correct responses during final Naming probes on Set 5 stimuli. All probe sessions are conducted under extinction conditions. Ph. = phase; MRET = multiple response-exemplar training.

sponses was lower in the final probe session compared with previous postnaming probe session. He emitted 12 untaught pure tacts (60%), ten impure tacts (50%), and 15 listener responses (75%). Scores on the final test showed that David achieved the listener component of naming according to the mastery criterion, whereas the speaker components decreased from 75% and 80% for the pure and impure tact responses, respectively, to 60% and 50% correct untaught speaker skills. Nina demonstrated 17 (85%) untaught pure and impure tacts and 15 correct listener responses out of 20 possible (75%). Consequently, Nina achieved full naming according to the mastery criterion. During the final test, Tom emitted four out of 20 pure and impure tacts and 15 out of 20 (75%) correct listener responses that were not directly taught. During the final naming-probe session, after two teaching sets with MRET, he did not perform the speaker component of naming. However, he demonstrated the listener component of naming according to the mastery criterion of 70% correct naming responses. Compared with baseline probes he increased his listener responses from five to 15 correct responses in 20 trials.

Discussion

The current study showed improved naming skills following MRET across two stimulus sets for three individuals with autism and, thus, support findings of previous studies (e.g., Fiorile & Greer, 2007; Greer, Stolfi, et al., 2005; Hawkins et al., 2009). Furthermore, the results support previous research which has shown that once naming skills are demonstrated with one stimulus set, children can acquire both listener and speaker responses from observing others vocal tacts of novel stimuli.

Prior to the MRET, none of the participants demonstrated extensive speaker repertoires. However, following training, all participants showed an increased portion of correct responding. All participants acquired the listener component of naming, and one participant, Nina, obtained a full naming repertoire. However, David displayed full naming during postnaming probes of Set 3, but not in the final test (Set 5). Tom showed the least significant progress in his speaker repertoire following MRET, although

he did perform the listener component of naming during the final test.

The results of the present study also differed from those of previous studies in certain respects that need explanation: First, one of the participants, Tom, showed a very modest improvement in naming skills following MRET. Tom's low scores probably resulted from a lack of explicit instructional experiences prior to the study. He was not able to sit relaxed at the teaching table for more than 2 to 5 min and was less compliant than the two other participants. When he responded incorrectly and there were no reinforcing consequences, and the trial was repeated, he could start to cry, slip down from the chair, or ask to play with other children. Because of the lack of service through an EIBI-program, we decided to continue the experiment with brief sessions when he smiled and appeared to enjoy the sessions. Tom also had a more limited repertoire of listener and speaker responses than Nina and David prior to the current study, although his repertoire was within the inclusion criteria for the present experiment. As Greer and Ross (2008) argued, naming skills may require specific prerequisites. Prior to the acquisition of naming, multiple listener and vocal tact responses must probably be taught directly. Most children with language delay will likely need extensive tact instruction before they are ready to learn the naming skills. As pointed out by Petursdottir and Carr (2011), a major issue for further research is to identify specific prerequisites for learning effectively from MRET.

Limited naming skills could reflect the absence of prerequisite skills for learning in the absence of structured instruction, or motivational variables. Being able to acquire tacts and listener responses with respect to novel stimuli incidentally, without explicit reinforcement, constitutes evidence of naming as defined by Horne and Lowe (1996). Before inclusion in the current study, two participants mastered the assumed prerequisites for naming, whereas Tom performances were slightly below the level of the recommended prerequisite skills on cooperation and reinforcer effectiveness on ABLLS-R.

Second, despite the fact that we completed MRET sessions with two stimulus sets in the present study, compared with only one set in Greer, Stolfi, et al. (2005), the participants in our study showed fewer correct untaught re-

sponses in accord with naming. The fewer correct responses, compared with what has been reported in previous research, could be due to negative reinforcement: After the child responded, whether correctly or not, to a presented stimulus, the stimulus (or the task) was removed, and a new probe trial was presented.

Another possible explanation of the lower percentage of correct responses in the current study, compared with previous research is that the sequence of naming probes in this study differed from previous ones. In this study, we probed naming by first testing pure tacts, then impure tacts and, finally, listener behaviors. By probing listener responses first, the participants in the studies by Greer and colleagues heard the name of the stimuli one more time just before the researchers tested pure and impure tacts. This additional exposure to the stimulus name (or tact) could be a variable that contributed to the overall greater portions of correct responding in accordance with naming (Fiorile & Greer, 2007; Gilic & Greer, 2011; Greer et al., 2007, 2011; Greer, Stolfi, et al., 2005; Greer, Yaun, & Gautreaux, 2005). Greer, Stolfi, et al. (2005) assumed that the slightly weaker scores in the last response class probed was due to prior test trials with the withholding of the reinforcer during probing. However, the last response type probed in Greer and coworkers studies was impure tacts, whereas in present study, the last probed response class was listener responses, where the participants had an additional opportunity to hear the tacts of the stimuli through the labeling of an adult ("Point to [the name of the stimuli]"). In spite of being probed last in the current study, the listener responses during the final probes were the highest number of correct responses. Hence, the current study cannot confirm whether the probe sequence impacts the emerged speaker and listener responses.

We made an adaptation based on Hawkins et al. (2009) and Longano (2008) who recommended incorporating the training of overt echoing of the names of the sample stimuli during MTS and listener trials included in MRET. The reason for this adaptation was to ensure attention to the auditory stimuli, and, hence, to increase appropriate listener responding, as well as joining the listener and speaker responses. We expanded the suggestion to the MTS instruction by giving the participants

chance to echoing the teacher's tacts, during the pre-training, before the naming probes were conducted. However, we obtained a slightly lower rate of appropriate listener responses than Greer et al. (2005) who did not require echoic responses in the matching instruction prior to naming probes. Thus, the results of the present study did not confirm the idea that the training of echoics would boost listener responses under naming probes. However recently, Longano and Greer (2014) measured occurrence of echoic responding during MTS with no requirements to do so and found a correlation between echoic responding and a strong naming repertoire.

One weakness of the current study, is the reinforcement of accurate MTS performance with the concurrent requirement of the participant's echoic of the verbal stimulus presented to them. Echoic in the presence of the novel stimuli, resembles a multicontrolled verbal operant (Cooper et al., 2007; Michael, Palmer, & Sundberg, 2011; Vargas, 2009). Because the visual sample stimulus was present along with the adult's tact, the MTS protocol could be assumed to produce a multicontrolled verbal operant, echoic, and tact. Thus, the pretraining could essentially involve tact training, prompted by echoics of the adult's tacts. On the other hand, all prenaming probes showed poor tact performance, compared with postnaming probes followed by MRET. Moreover, if the pretraining actually involves tact training, poor performance during subsequent probes could theoretically reflect that prompts were not effectively faded out from the MTS tasks with echoic of the teacher's tacts. However, all prompts were faded until responding occurred without prompts and after at least a 5-min break, prior to the naming probes.

An additional concern of the present study, as well as in previous studies, is the sources of improved listener performances during naming probes. Potentially, characteristics of the MTS protocol could imply that those skills were directly taught, when the teacher tacted the novel stimuli while the participant placed the sample stimulus on the comparison. However, the result showed increased listener responding after MRET, compared with during the prenaming probes.

In the current study, as well as in previous studies, a likely weakness is limited stimulus control over responding during MTS instruc-

tion. The adult's tact (an auditory stimulus) presented during MTS prior to naming probes probably did not control the responding. The responses to the matching instruction could be controlled solely by the visual stimuli, as a result of prior exposure to discrimination training. The MTS tasks in the current study consisted of training with compound stimuli (verbalization of the tacts in addition to visual stimuli). However, the compound stimuli probably did not acquire stimulus control over listener behavior. The stimulus control established in earlier discrimination training could hinder stimulus control by compound stimuli. Hence, as described in the phenomena overshadowing and blocking (Cooper et al., 2007), the training of compound stimuli, such as by adding the adult's tact, probably did not control responding during MTS. On the other hand, we attempted to avoid overshadowing and blocking by requiring the participants to echo the adult's tact to ensure listening through covert echoic. The purpose of requiring the echoic was to control covert self-echoics, as well as to make the behavior accessible for observation and measurement for other persons. The occurrence of an overt echoic response (or listening) could ensure naming skills during probing. Nevertheless, whether requiring overt echoic responses contributed to the occurrence of appropriate listener responses was not confirmed.

The current study, as well as previous studies that aimed to induce full naming through MRET, probably have another common limitation. The weakness is an inability of the experimental design to isolate the effects of MRET from the effects of the pretraining consisting of repeated exposures to the test stimuli through MTS with the adult's tacts of the novel stimuli and subsequent naming probes (Petursdottir & Carr, 2011). Each participant received pretraining of MTS instruction with the adult's tacts with Set 1 and 3 stimuli prior to MRET. Therefore, improved naming performances under post-naming probes with those sets following MRET may be attributed to continued exposure to MTS instruction and the actual naming probes, rather than to MRET. The effect under the postnaming probes with Set 1 and 3 stimuli could be a learning-to-learn effect regardless of the influence of MRET, or a product of both. However, the result showed apparent differences of responding during prenaming probes

compared with postnaming probes, which likely is in favor of MRET. Moreover, all participants exhibited higher correct naming skills on the final test with Set 5 stimuli that were for the first time introduced, compared with the initial exposure to Set 1 and 3.

The challenge is a reliable test of full naming performance, where appropriate speaker and listener responses are emerged from observation of others tacts. The current study used a test protocol similar to the one used by Greer and colleagues where the participants observe the novel name-object relations during MTS, which comprised of correct matching skill in the presence of the teacher's tacts of the sample stimulus, with and without the requirement of echoing the teacher's tacts. Recently, Carnerero and Pérez-González (2014) have suggested an alternative naming test which they called pairing naming. They exposed the participants for novel vocal name–object relations repeatedly until tact performances were acquired. When tacting skills were acquired, they probed impure tact and listener skills with the same stimuli. The test protocol is similar to what Rosales, Rehfeldt, and Huffman (2012) call stimulus pairing observation procedure (SPOP). SPOP means that the participants are exposed to pairs of related stimuli, such as a visual stimulus along with an auditory stimulus which is another's tact of the visual stimulus.

Although the most reliable test of naming skills may be the one proposed by Horne and Lowe (1996), that the test consists of the establishment of tact responses to mastery before testing listener responses, or vice versa. It cannot possibly determine whether the child has obtained full naming, where both speaker and listener responses emerge out of solely an incidental observation of a tact of an unknown stimulus. Full naming may be more interesting, because it seems closer to how children typically learn new words, both as listener and speaker, in their natural environment without explicit reinforcement.

To establish naming in children with autism, MRET will probably facilitate learning from everyday experiences and expand the verbal repertoire without direct teaching. Indeed, Greer et al. (2011) suggested that the onset of naming skills are a source of how children come to learn incidentally, how the children can be taught in general and more particular how chil-

dren can be taught in school. Opposite, the lack of naming skill is assumed to indicate that the child cannot be taught effectively. Furthermore, it is assumed that established naming skills provide access to teaching based on using model presentations, which is necessary for learning to occur in, for example, regular classrooms. Naming skills probably increase learning outcomes in children (Greer et al., 2011). Therefore, the emergence of naming should be an important early objective in language training programs.

Children with autism are characterized by the lack of or deviant development of language. Often, children with autism need a large number of discrete-trial teaching trials in order to acquire basic language functions, such as echoic, pure and impure tacts, and listener responding. Children with autism often need direct teaching over several years in order to achieve these fundamental verbal functions and other more complex social skills, and may still have difficulty "picking up" novel words. Even after years of training, some children may not learn names of unfamiliar stimuli through incidental observations of someone tacting a novel stimulus in the environment. Greer et al. (2011) and Greer and Ross (2008) have found faster learning when naming has been established, in participants with autism, with language delay, and with developmental disorders, as well as in normally developing children. Children without naming skills are assumed not to profit from teacher demonstrations, as often used in classrooms.

The findings of the present study support the suggestion that variables that produce naming can facilitate incidental learning of verbal behavior. This study did not confirm the assumption that listener behavior would increase more when the participants were required to echo the name of the novel stimuli during MTS prior to naming probes. Further research is needed in order to identify how echoic behavior has impact on the acquisition of naming. In addition, research that identify specific prerequisites for learning effectively from MRET seems crucial. Research on how children with autism can most effectively acquire naming skills may be particularly important, because of its relevance to the children's acquisition of new word–object relations without explicit training and for the potential improvement of their possibility to learn through classroom teaching with their peers.

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