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## Massed versus Embedded Trial Arrangements: Teaching Community Signs to Children with Autism Spectrum Disorder

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### Abstract

The aim of this study is to compare the effectiveness and efficiency of teaching the meaning of community signs with massed trial arrangements (MTA) and embedded trial arrangements (ETA) using constant time delay intervention. This intervention was carried out through two different arrangements: MTA versus ETA. The study was conducted with four boys with Autism Spectrum Disorder aged between 44-64 months. An adapted alternating design was used. The arrangements were equally effective in terms of the number of sessions required for participants to learn the meaning of the signs. However, MTA sessions were much shorter. The arrangement preferred by the participants was examined: Two chose MTA and two chose ETA.

**Keywords:** Constant time delay, massed trial arrangements, embedded trial arrangements, community signs, autism spectrum disorder.

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Applied Behavior Analysis (ABA) principles are evidence-based implementations that have proven effective and efficient in multiple studies with children with autism spectrum disorder (ASD) throughout 1960s and 1970s (Haq & Aranki, 2019; Lerman, Valentino, & LeBlanc, 2016). The first effective ABA implementation included Discrete Trial Teaching (DTT). This was eventually replaced by Errorless Teaching Methods (ETMs), which were systematically more developed (Ault, Wolery, Doyle, & Gast, 1989; Wolery & Gast, 1984). Constant Time Delay (CTD) is one of the most used ETMs (Roark, Collins, Hemmeter, & Kleinert, 2002; Rogers, Hemmeter, & Wolery, 2010; Wolery, Ault, Gast, Doyle, & Mills, 1990). CTD interventions can be presented via massed trial arrangements (MTAs) as well as embedded trial arrangements (ETAs; Wolery, Anthony, Caldwell, Snyder, & Morgante, 2002).

MTAs are carried out during an instructional session of consecutive trials with a short interval between each trial, usually a few seconds (Ledford, Chazin, Harbin, & Ward, 2017). The trainer and child sit by facing each other. Correct responses are rewarded with food, toys, or activities the child enjoys (Bozkurt & Gürsel, 2005; Kırcaali-İftar, Ergenekon, & Uysal, 2008; McGee, Krantz, & McClannahan, 1985). MTAs have some benefits for children with developmental disabilities. They are more effective for children with poor learning speed and those who cannot benefit from traditional educational settings. They can be maintained with fewer errors and the targeted behavior can be acquired in less time (Kırcaali-İftar & Tekin-İftar, 2012; Doyle, Wolery, Ault, & Gast, 1988). Although many studies have confirmed the effectiveness of MTAs, there are shortcomings. The motivation of ASD children is lower, interventions are conducted in structured settings that do not resemble the daily lives of children, target behavior can be presented robotically, and there results depend on the reward. All of these can make studies clinically or socially less valid (Geiger et al., 2012; Schreibman et al., 2015).

ETAs usually involve ongoing activity that is unrelated or loosely related to the behaviors to be taught (Wolery, Anthony, Caldwell, Snyder, & Morgante, 2002; Wolery & Hemmeter, 2011). ETAs incorporate structured learning opportunities into naturally occurring activities (Daugherty, Grisham-Brown, & Hemmeter, 2001; Ledford et al., 2017). These arrangements are effective and show high levels of maintenance and generalization to novel settings (Mirenda-Linne & Melin, 1992). ETAs can be used with a variety of routines and transitions as well as planned play activities (Geiger et al., 2012; Haq & Aranki, 2019; Ledford et al., 2017). Play is a joyful activity. Therefore, when the targeted skills are embedded in play, children learn these skills without the need for rewards. Play-based activities are more child-oriented and can be shaped according to the interests of the child (Geiger et al., 2012). Previous studies show that ETAs result in a smaller number of problematic behaviors and have a slightly more positive effect than MTAs (Delprato, 2001; Geiger et al., 2012; Sigafoos et al., 2006). Both MTAs and ETAs have been used successfully in early childhood contexts (Grisham-Brown, Pretti-Frontczak, Hawkins, & Winchell, 2009; Grisham-Brown, Ridgley, Pretti-Frontczak, Litt, & Nielson, 2006; Ledford et al., 2017; Seward, Schuster, Ault, Collins, & Hall, 2014; Swain, Lane, & Gast, 2015). Although many studies have confirmed the effectiveness of ETAs, there are shortcomings. For example, some naturalistic interventions may not include sufficient number of learning trials (Geiger et al., 2012) and procedural fidelity may be insufficient (Schreibman et al., 2015).

Only three studies were found that compared the effectiveness and efficiency of MTAs versus ETAs during play (Geiger et al., 2012; Haq & Aranki, 2019; Ledford et al., 2017). In the first study, Geiger et al. (2012) taught the names of animals to children with ASD. Both methods were equally effective and efficient. In the second one, Ledford et al. (2017) taught letter sounds or vocabulary to children with developmental disabilities. The results were mixed. Neither ETA nor MTA was best for all students. In the third study, Haq and Aranki (2019) compared MTA and ETA in terms of instructional targets and problem behavior by including one child with ASD. Although both approaches yielded similar results, there was more exposure to target behaviors and no problem behavior was observed during ETA. Due to the number of previous studies and their findings, there is still a need for studies that compare these arrangements.

Despite the effectiveness of both arrangements, the learning preferences of the students need to be identified. In the literature, the preferences of the participants for MTAs or ETAs are unclear. There are only two

studies which evaluated the preferences of the participants (Geiger et al., 2012; Ledford et al., 2017). Geiger et al. (2012) used pictures to assess the preferences of the participants. One child reported that he consistently preferred to learn during play. The other child was unsure. Ledford et al. (2017) used flashcards to assess the preferences. Four participants had a clear preference for ETA and MTA, respectively. One participant chose ETA more often. It is seen that there is still a need to assess the participants' preferences. The present study includes four research questions:

1. Is there any difference in the effectiveness and efficiency of presenting CTD trials with MTAs and ETAs when teaching community signs?
2. Is there any difference between presenting CTD trials with MTAs and ETAs in terms of the generalization of acquired community signs across new settings and trainers?
3. Is there a difference between presenting CTD trials with MTAs and ETAs in maintaining the acquired skills one, two, and five weeks after training?
4. Which arrangements do participants prefer?

### **Method**

#### **Participants**

The study was conducted with four boys with ASD (Table 1): Metin, Ozan, Mehmet, and Halil. The pilot study was also conducted with another boy. All participants attended group activities during the week at a university unit for developmental support. They also attended a public or private preschool for 15 hours a week on weekdays. They all took two sessions at a rehabilitation center during the week. The prerequisites were the following: (a) Having an ASD diagnosis or a pervasive developmental disability, (b) making eye contact for at least four seconds, (c) participating in the activity at the table or during a play activity for at least five minutes, (d) speaking on a topic with at least two-word sentences, (e) choosing the reward by pointing or naming it, (f) following two-step directions, and (g) playing a game and following the rules.

#### **Researchers and Observers**

The first author holds a BA degree in special education and an MA in ABA. The second author holds a PhD in Special Education and has a role in designing and writing the study. The two observers have undergraduate and graduate degrees in special education.

#### **Settings**

Baseline, intervention, probe, maintenance, and preference sessions were conducted in the individual psychological support room in the unit. The study was conducted on weekdays between 13.30–17.00 by the first author. Generalization sessions were conducted in individual rooms. The area was nearly twenty square meters and contained a chair, a cupboard, a table, and some teaching materials.

#### **Materials**

The following materials were used during the baseline, intervention, generalization, maintenance, and preference sessions: (a) 5 cm models of community signs, similar to the real ones (28 signs) (5 + 5 signs for both interventions, 5 signs for the control set, 10 + 3 signs for preference sessions) (Table 2), (b) data collection forms, (c) a Twister game set, (d) a Cricket game set, (e) five toy cars of different colors and models, (f) a model house, plastic trees, and colored tape, (g) snacks and (h) a video camera (Sony HD) and tripod.

Table 1

*General Characteristics of the Participants*

Participants	Age (Month)/ Gender	Diagnosis	GARS-2-TV* Score/Result	Intelligence Scale/Score
Metin	64 Months/M	ADHD and ASD DSM-IV-TR**	77/Autism possibility	WISC-R****/110
Ozan	65 Months/M	A-typical Autism ICD-10***	99/Autism possibility	WISC-R****/112
Halil	54 Months/M	ADHD and ASD DSM-IV-TR**	94/High possibility of autism	Stanford Binet*****/98
Mehmet	44 Months/M	Asperger Syndrome DSM-IV-TR**	107/High possibility of autism	Stanford Binet*****/130

\*The Gilliam Autism Rating Scale-2 Turkish Version, \*\*DSM-IV-TR (Diagnostic and Statistical Manual of the Mental Disorders), \*\*\*ICD-10 (International Statistical Classification of Diseases and Related Health Problems), \*\*\*\*WISC-R (Wechsler Intelligence Scale for Children, revised) Turkish Version, \*\*\*\*\*Stanford-Binet Intelligence Scale (Manual for the Third Revision: Form L-M) Turkish Version.

**Design**

The study used an adapted alternating-treatment design in order to compare the effectiveness and efficiency of presenting CTD trials with MTAs and ETAs. The researchers gave attention to the following to ensure experimental control: The selection of dependent variables with equal difficulty in terms of the syllable length, first letters, geometric shapes and color, number of letters or figures. The opinions of the special education professionals about the teaching sets were asked. The arrangements for the instruction sets were randomly assigned. The order of the implementation of the independent variable was changed each day. The implementation of the variables was ensured within at least one-hour intervals. A control set that was very similar to the instruction materials was prepared to use in the intervention sessions which were conducted intermittently.

**Independent and Dependent Variables**

There are two independent variables in the study: (1) CTD trials with MTAs and (2) those with ETAs. The dependent variable of the study was the ability to correctly name the community signs. The community signs were selected according to: (a) The knowledge of the participants related to signs (b) the signs they were likely to see on their way to school and (c) the opinions of the participants and parents on which signs were useful to teach (Table 2).

**Identifying Participants' Reward Preferences for MTAs**

Before starting the study, the rewards to be used during MTAs were identified via stimulus-based trials. The rewards were snacks and activities.

**Identifying Participants' Play Preferences for ETAs**

The play development, chronological age values and preferences of the participants were considered in the identification of the play activities. The information was received from the parents and teachers. The participants were also observed during play by the researchers. When possible, the game materials were placed in different corners of the classroom. The participants were taken to the room in a particular order. The researcher had a short conversation with the participants regarding the games. She asked them which game or activity they preferred. The participants preferred Twister, Cricket, and a road construction game in terms of the ETAs.

**Baseline and Daily Probe Sessions**

Baseline sessions were conducted before the instruction sessions. During these sessions, the participant and the trainer sat by facing each other. The researcher asked questions such as "Tell me, which sign is this?". After four seconds, she recorded the responses. Following the session, the participants were reinforced verbally.

Table 2  
*Community Alert Signs that Were Used in the Study*

Participant	The CTD set via MTA	The CTD set via ETA	Control set*	Teaching set in the activity of making a choice*	Teaching set to be used with the preferred arrangement*
Metin	-Bus stop -School pass -Swimming place -Mending -Park	-Hotel -Underpass -Service area -Hospital -Picnic area			
Ozan	-Hotel -Underpass -Service area -Hospital -Picnic area	-Bus stop -School pass -Swimming place -Mending Park	-First aid -Tunnel -Camping -Youth camp	-Overpass -Pedestrian road -No bicycle	-Attention -Electric -Slippery slope -Stop -Pass -Restroom Ladies -Restroom -Gentleman -Pharmacy -Emergency meeting area -Exit
Halil	-Bus stop -School pass -Swimming place -Mending -Park	-Hotel -Underpass -Service area -Hospital -Picnic area	-Pedestrian -Walkway		
Mehmet	-Hotel Underpass -Service area -Hospital -Picnic area	-Overpass -Pedestrian road -No bicycle			

\*These community alert signs were used for all participants.

Baseline data for ETA were collected during the game that the participants preferred. The researcher asked for the name of the signs and waited four seconds for a response. The participants were praised for taking part. The responses were video recorded. Daily intermittent probe sessions were conducted. These sessions were similar to baseline ones. The instruction sessions ceased when the participants met nine out of ten criteria for consecutive correct responses.

### MTA Instruction Sessions

MTA training sessions were conducted in two phases, beginning with zero-second interval trials. The signs were shown one after another as naming the community signs was a single-step behavior. The participants were also high functioning. During these procedures, the professionals' advice was taken into consideration. At the beginning of the instruction, a zero-second interval trial for both MTA and ETA was conducted. During these sessions, the participants were asked to name five community signs in a random order. Ten trials were carried out per session.

The sessions were carried out through the following arrangements: (a) The setting and materials were prepared. (b) The researcher and the participant sat together by facing each other. (c) The researcher secured the participant's attention with a prompt (e.g. "Now we are going to teach you some signs, and at the end of the study you will earn whatever reward you want"), (d) showed the rewards and placed the preferred one at the far corner of the table, (e) asked if the participant was ready, (and when the participant affirmed this verbally or nonverbally) reinforced the participant, (f) presented the target stimuli (e.g. "Tell me, which sign is this?") and provided the controlling prompt simultaneously (e.g. "school pass, swimming pool, etc."), (g) provided verbal praise after the participant repeated the prompt or provided the same prompt if the participant did not respond or responded

incorrectly or incompletely, (h) waited two to five seconds between trials, (i) presented the signs in a random order, (j) told the participant that s/he had finished the study, provided verbal praise, and gave the reward directly, (k) left the table and ended the session.

*Constant time delay trials:* The allowed response time was 4 seconds. The instruction was similar to that of the zero-second interval sequence.

### **ETA Training Sessions**

ETA training sessions were conducted in two phases, beginning with zero-second interval trials. Five targeted community signs were embedded into the games preferred by the participants in a random order in each of ten intermittent trials. Due to the nature of the games, the intervals were not predetermined.

These training sessions included the sequences in the following: (a) The game and materials were prepared. (b) The researcher and participant sat on the floor by facing each other. (c) The researcher provided the prompt for securing the child's attention (e.g. "Now we are going to play Twister and dance, and then we are going to topple the signs, OK?"), (d) praised the child verbally for participating, (e) played the game and when the targeted signs came up, asked for their name (e.g. "Tell me, what is the name of this sign?"), and provided the controlling prompt immediately (e.g. school pass, swimming pool, etc.), (e) provided verbal praise for repeating the prompt, if the response was incorrect or incomplete, (f) continued to play the game, (g) told the participant that s/he could end the game at an time after ten trials in random order, (i) verbally praised the appropriate behavior of the participants during the sessions, and (j) ended the session and left the instruction setting.

*Constant time delay trials:* The allowed response time was four seconds. The instruction was similar to that of the zero-second interval sequence.

### **Generalization and Maintenance Sessions**

Generalization sessions were conducted in different settings, materials, and people (one people, one material and one setting in every sessions). They were carried out in only one pre-test and post-test session using both MTA and ETA. Maintenance sessions were conducted after one, two, and five weeks.

### **Preference for Arrangement Type**

Regardless of teaching methods, the preferences of the participants were examined in preference sessions which were conducted after participants met the criteria through MTA and ETA. The participant was first asked to make a choice and this preference was added into the instruction.

**Teaching to choice.** During this phase, a visual prompt was provided to the participant in order to identify his preference and to remind them of the two methods utilized in the study. The pictures of the setting and an empty chair were used to ensure that the participants made their choices consciously. The goal was to teach three community signs during these sessions that continued until it was clear that the participants made conscious choices.

The sessions via MTA and ETA were conducted with the following sequences: (a) Three pictures of different teaching settings were shown and a short conversation was held about them, (b) the picture of the table and reward were shown and the participant was asked to choose verbally or non-verbally, (c) the participant was told that he would earn his preferred reward which was put on the table, (d) a zero-second waiting interval instruction session with three trials using the teaching set at a table was carried out, (e) the participant was given the reward, (f) the procedure was explained to the participant, e.g. "You chose the table and earned the [reward]," and (g) the participant was verbally praised. Unlike MTA sessions, the ETA ones included different questions such as "What did we do now? You chose the game, and we played that game. What did we learn?" in which the function of the game was explained and no reward was used.

**Teaching to choose the empty chair.** The following sequence was conducted for teaching to choose the empty chair: (a) Three pictures of different teaching settings were shown and a brief conversation was held about them, (b) a picture of an empty chair was shown to the participant and he was asked to choose verbally or non-verbally, (c) the participant sat on a chair and the researcher did not make any contact with him for approximately one minute, (d) the empty chair picture was shown and the questions such as “What did we do now? You chose the empty chair and we just sit, did anything. What did we learn? We learnt nothing.” were asked, (e), the goal of choosing the empty chair was explained to the participant, and (f) s/he was praised for participating. This part was conducted for both arrangements (MTA and ETA).

### **Training Sessions Conducted with Preferred Arrangements**

After completing the sessions, new instruction sessions were conducted with a different set of signs. These sessions continued until the participants met nine out of ten of the correct response criteria. At the beginning of each training session, the participants were asked which teaching method they preferred and the session was conducted with the preferred method.

### **Maintenance Sessions for Preference Sessions**

Maintenance sessions were conducted 5, 10, and 15 days following both MTA and ETA preference sessions. The sessions were conducted like instruction sessions.

### **Data Collection**

**Effectiveness, efficiency, and generalization.** The correct and incorrect responses were recorded during baseline, instruction, maintenance, and generalization sessions. The correct response percentage was referred to a measure of effectiveness for each type of arrangement. The efficiency was based on the number of sessions in each phase, the number of trials, the percentage of incorrect responses, and the length of teaching sessions. Generalization data were collected in the pre-test and post-test sessions. All data were collected by the first author.

**Reliability.** Two kinds of reliability data were collected: (a) inter-observer agreement (IOA) data and (b) treatment integrity (TI) data. Reliability data were collected and analyzed from 30% of randomly selected sessions from each phase. IOA data were calculated by using point-by-point method, dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100 (Billingsley, White, & Munson, 1980; Tekin-İftar & Kırcaali-İftar, 2016). TI data were calculated by dividing the number of observed behaviours by the number of planned behaviours and multiplying the result by 100 (Billingsley et al., 1980; Tekin-İftar & Kırcaali-İftar, 2016).

**Preference sessions.** The preferences of the participants were asked. The photographs of each arrangement were taken during the study. At the beginning of each session the participant was asked, “Now I am going to teach you some new signs. How would you like to learn these signs?” The preferences were asked during baseline, intervention, and maintenance sessions.

## **Results**

### **Effectiveness**

Metin, Ozan, and Mehmet gave no correct responses during the baseline sessions that included both implementations. Halil gave no correct responses during MTA baseline session but 3.33% with ETA. As soon as the training sessions began, Metin, Ozan and Mehmet showed improvement in both MTA and ETA. Correct responses increased to 100% (Figure 1, Figure 2, Figure 4, Table 3). Due to the inconsistency in Halil’s data, some adaptations were made after the twelfth session. Following these changes, Halil also gave 100% correct responses in both MTA and ETA (Figure 3 and Table 3).

One, two, and five weeks after the intervention sessions, Metin maintained 90%, Ozan, Halil, and Mehmet maintained 100% correct response rate for MTA. For ETA, all four participants maintained 100% correct response

rates. Regarding the intermittent probe sessions which were conducted with the control set, the participants did not acquire the community signs (Figure 1, Figure 2, Figure 3, Figure 4).

**Generalization**

Generalization data showed that all participants had 0% accuracy during pre-test generalization sessions that included both MTA and ETA. After the instruction sessions, the participants had 100% accuracy in post-test generalization sessions that included both MTA and ETA across new settings and trainers (Figure 1, Figure 2, Figure 3, Figure 4).

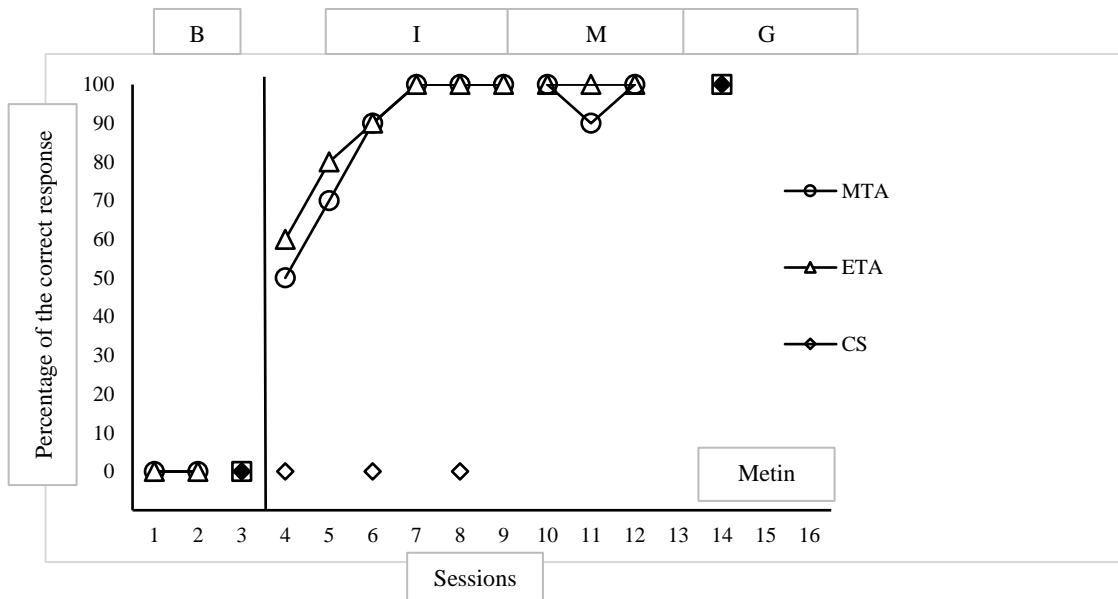


Figure 1. Metin's percentage of correct responses. B: Baseline, I: Intervention, M: Maintenance, G: Generalization, MTA: Massed Trials Arrangements, ETA: Embedded Trails Arrangements, CS: Control Set.

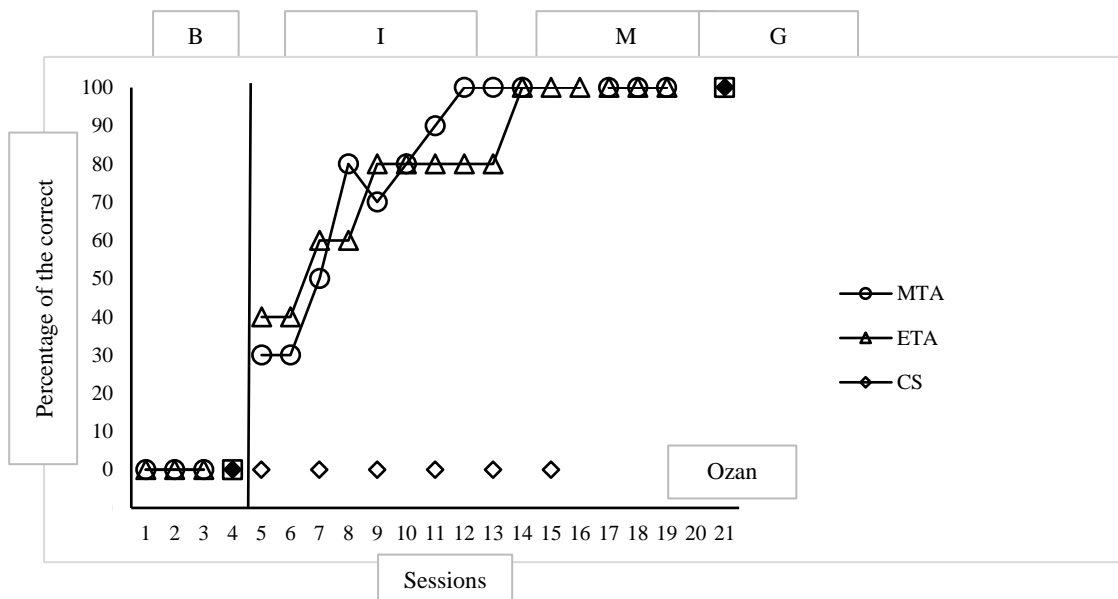


Figure 2. Ozan's percentage of correct responses. B: Baseline, I: Intervention, M: Maintenance, G: Generalization, MTA: Massed Trials Arrangements, ETA: Embedded Trails Arrangements, CS: Control Set.



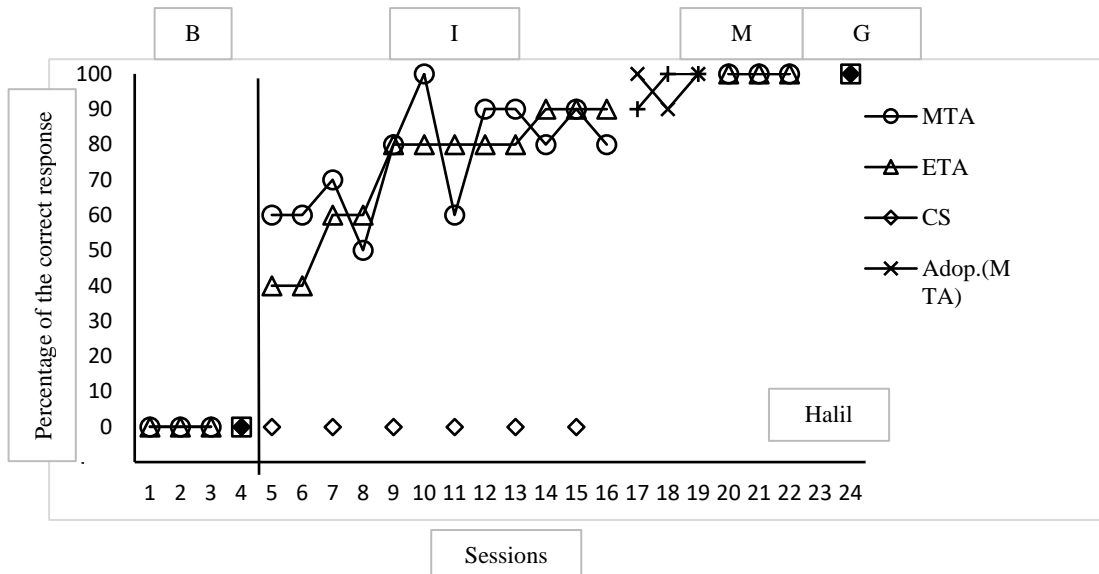


Figure 4. Halil's percentage of correct responses. B: Baseline, I: Intervention, M: Maintenance, G: Generalization, MTA: Massed Trials Arrangements, ETA: Embedded Trails Arrangements, CS: Control Set.

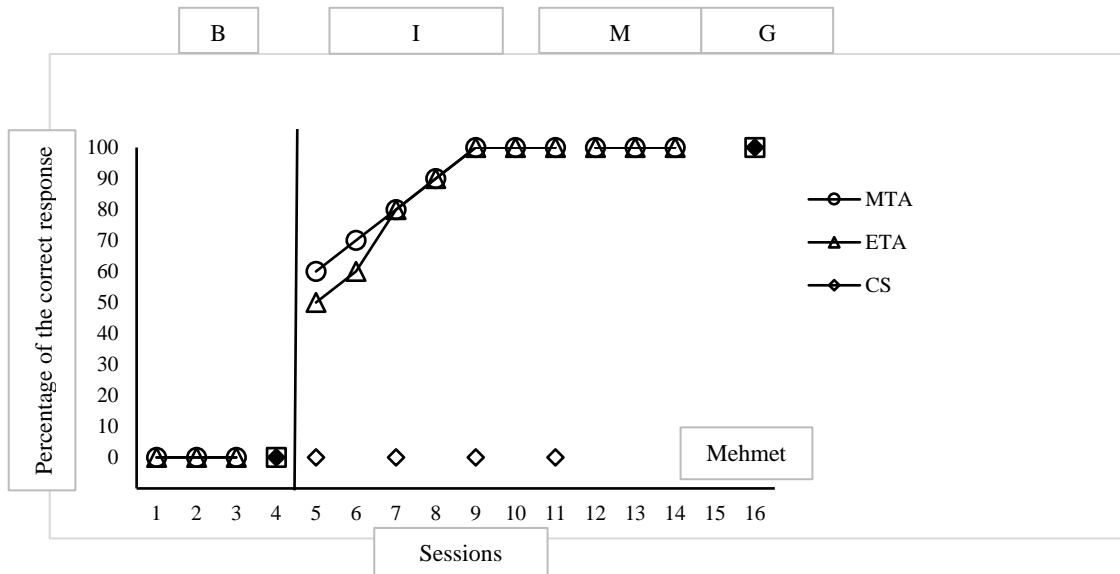


Figure 5. Mehmet's percentage of correct responses. B: Baseline, I: Intervention, M: Maintenance, G: Generalization, MTA: Massed Trials Arrangements, ETA: Embedded Trails Arrangements, CS: Control Set.

### Efficiency

The number of sessions, trials, incorrect responses, and the time until the criteria (sec.) were met were taken into consideration while examining the efficiency of MTA and ETA (Table 3). Metin and Mehmet acquired the targeted skills through both MTA and ETA following an equal number of sessions. Ozan acquired the targeted

skills through MTA, which was faster than ETA. Although Halil received 12 training sessions that included both MTA and ETA, he could not meet the criteria. After some modifications, he met the criteria for both arrangements at the end of the fifteenth session. Metin and Ozan met the criteria in MTA sessions by the half of the ETA sessions. Similarly, Mehmet met the criteria in MTA sessions at the end of one third of the ETA sessions. Halil met the criteria in MTA sessions when the two-thirds the of the ETA sessions were conducted, including the sessions conducted with the modifications. As shown in Table 3, there were fewer incorrect responses with MTA than ETA in trials that belonged to Ozan, Halil and Mehmet.

### Reliability

IOA data were calculated with a mean of 92%-100% for MTA and 84%-100% for ETA. The researchers agreed with a mean of 92%-100% for MTA and 94%-100% for ETA in each experimental condition across participants.

Table 3

#### *Efficiency Results of the Study*

Participant	Implementation/ Skill	Number of sessions	Number of trials	Number/percentage of incorrect responses	Time min:sec
Metin	MTA	6	60	9-18%	15:46
	ETA	6	60	7-14%	38:46
Ozan	MTA	10	100	27-27%	35:98
	ETA	12	120	30-27.7%	74:89
Halil	MTA	12	120	29-24.16%	57:53
	ETA	12	120	33-27.5%	97:41
	Adaptation	6	60	2-3.33%	18:06
Mehmet	MTA	7	70	10-14.28%	22:63
	ETA	7	70	12-17.14%	71:35

### Preferences

Prior to the preference sessions, Metin always said he wanted to learn via ETA whereas Ozan and Mehmet preferred MTA. Halil preferred MTA once and ETA for the rest of the training sessions. Metin, Ozan, Halil, and Mehmet met the 100% correct response criteria for the targeted skills in the tenth, eighth, tenth, and eighth instruction sessions, respectively. During maintenance sessions, Metin, Ozan, and Mehmet maintained 100% accuracy and Halil maintained 93.3% accuracy (Figure 5, Figure 6, Figure 7, Figure 8).

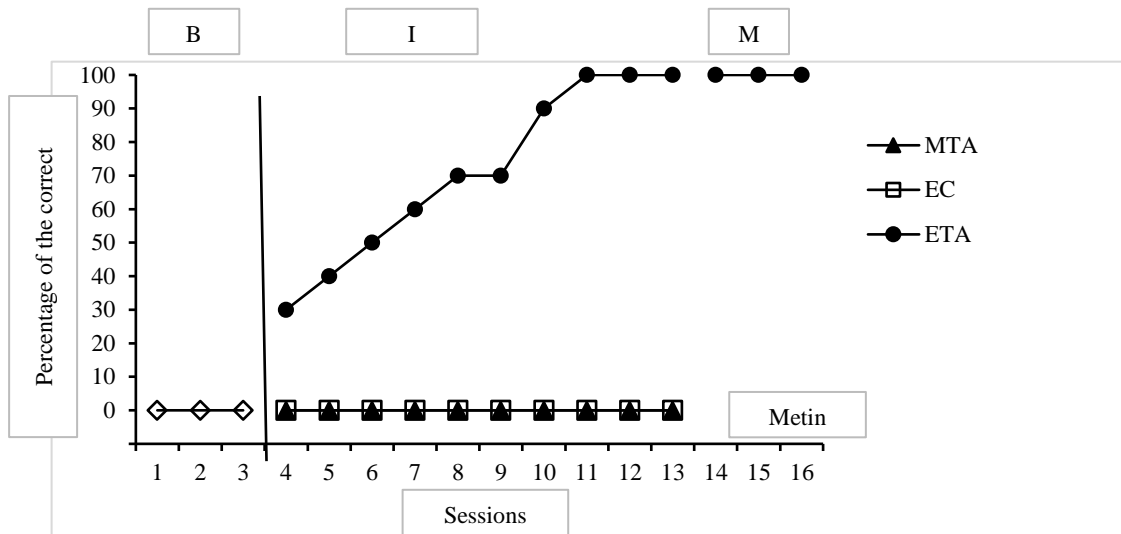


Figure 6. Preference sessions of Metin. B: Baseline, I: Intervention, M: Maintenance, MTA: Massed Trials Arrangements, ETA: Embedded Trials Arrangements, EC: Empty Chair.

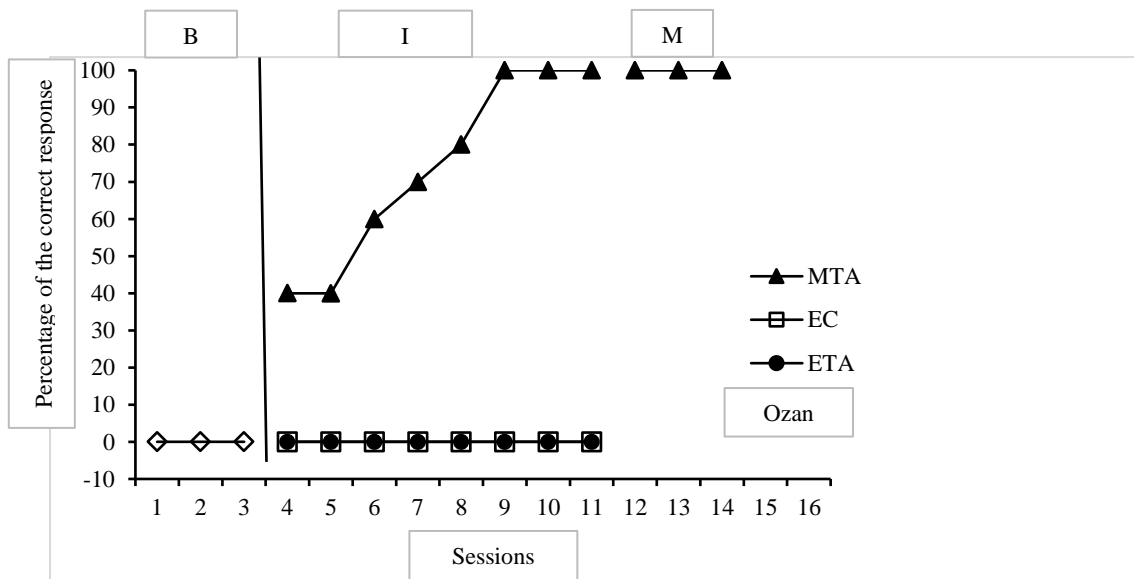


Figure 7. Preference sessions of Ozan. B: Baseline, I: Intervention, M: Maintenance, MTA: Massed Trials Arrangements, ETA: Embedded Trials Arrangements, EC: Empty Chair.

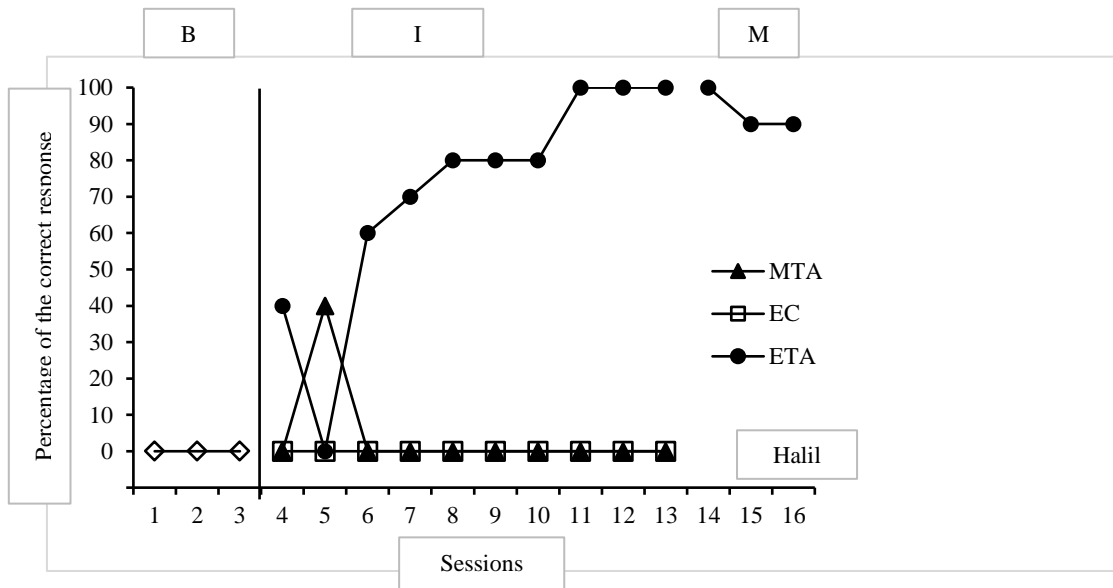


Figure 8. Preference sessions of Halil. B: Baseline, I: Intervention, M: Maintenance, MTA: Massed Trials Arrangements, ETA: Embedded Trails Arrangements, EC: Empty Chair.

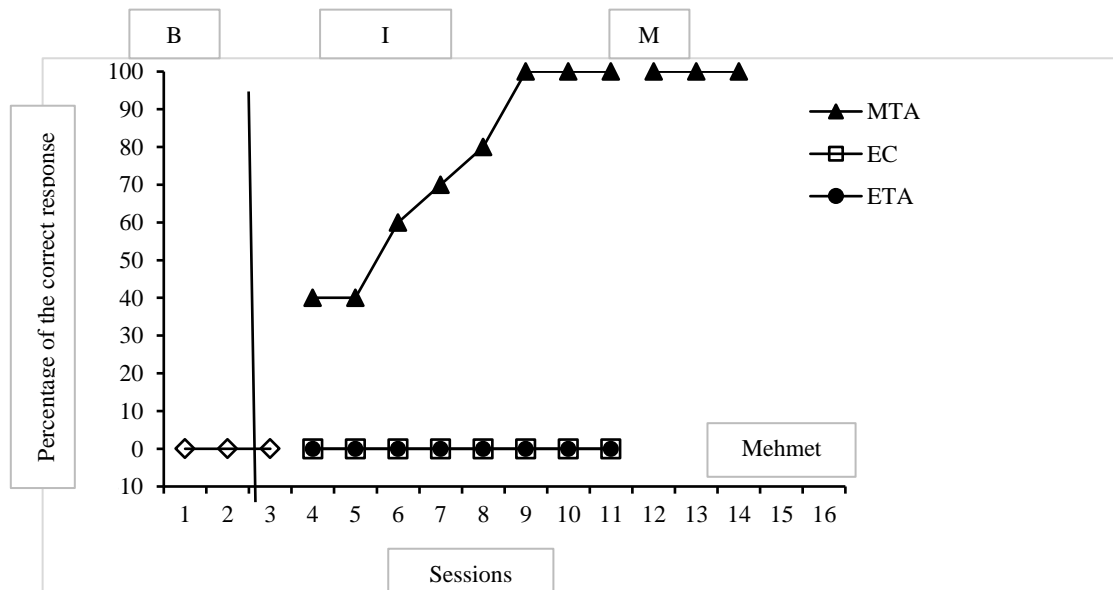


Figure 9. Preference sessions of Mehmet. B: Baseline, I: Intervention, M: Maintenance, MTA: Massed Trials Arrangements, ETA: Embedded Trails Arrangement,s EC: Empty Chair.

### Discussion

The purpose of this study was to compare CTD instruction via MTA or ETA in teaching community signs to four children with autism. The results of the present study show no difference in effectiveness between the two arrangements for Metin, Ozan, and Mehmet. These results are consistent with those of Geiger et al. (2012) and Ledford et al. (2017). MTA was more effective for Halil. This result is consistent with one child in Ledford et al. (2017).

The effectiveness data were consistent with previous studies that utilized MTA. Academic skills, expressive language skills, self-help skills, labelling, and community signs were studied (DiPipi-Hoy & Jitendra, 2004; Norman, Collins, & Schuster, 2001; Tekin-Iftar, Kurt, & Cetin, 2011). Similarly, the effectiveness data was consistent with studies that used ETAs. Cognitive, language, motor, and transition skills were studied (Chiara, Schuster, Bell, & Wolery, 1995; Daugherty et al., 2001; Grisham-Brown, Schuster, Hemmeter, & Collins, 2000; Grisham-Brown et al., 2006, 2009; Wolery, Doyle, Gast, Ault-Jones, & Simpson, 1993). No difference was found between the two arrangements as also confirmed by similar studies (Flores, Houchins, & Shippen, 2006; Hughes & Fredrick, 2006; Tekin-Iftar et al., 2011; Yilmaz, Birkan, Konukman, & Erkan, 2005).

In terms of efficiency, the length of MTA training sessions was shorter than ETA sessions. Metin and Mehmet acquired the target skills in the same number of training sessions for both implementations. Ozan acquired the target skills with a one-session difference. Although presenting CTD via MTA seems to be more efficient based on the length of sessions, it can be said that participants acquired the skills in an equal number of sessions in both implementations. This is a noteworthy result.

In order to show that the changes in the dependent variables were only the result of the independent variables, intermittent probe sessions were conducted with a control set that was similar to the other sets. The participants could not make correct responses in the initial probe sessions with the control set, which can be considered a strength of the experimental control of the study. No other studies in the literature used only response prompts or presented them in natural settings such as play, and also conducted probe sessions with control sets. Therefore, this finding contributes to the current literature.

In terms of preferences, Geiger et al. (2012) utilized the preferred implementations of the participants. The results showed that one participant consistently preferred ETA whereas the other one had inconsistent preferences. In the present study, the preference sessions followed a similar method. Metin and Halil consistently preferred ETA whereas Ozan and Mehmet consistently preferred MTA. Hence it is unclear which arrangement is superior, which is an important contribution to the debate on MTA versus ETA instruction.

The effectiveness data are positive. Three out of four participants learned the signs without the need for specific adaptations. The fourth participant (Halil) did not learn them. Therefore, a modification was adopted through instructions such as "Look. Tell me, which sign is this?" to draw his attention to the sign. A tablet computer which was his preferred reward was also added. Halil learned the signs with 100% accuracy following these adaptations. One possible reason for the instability of Halil's data could be his frequent epilepsy seizures and the effects of the medication.

Two baseline sessions were conducted with Metin as he would get upset and apologize when he did not know the meaning of a sign. The baseline was divided into two sessions in order to prevent possible negative effects of repeatedly asking questions whose answers he did not know and to overcome ethical concerns. This provided flexibility for the researchers. Metin was able to get used to the procedure. Although he did not know the answer in the preference sessions, he mentioned that he knew the procedure and would learn the signs over the course of the study. Hence three baseline sessions were conducted for preferences. Possible reasons for Metin's initial response might be due to ASD, his personality (e.g., getting angry when he does not know the answers to the questions and failure anxiety). This can be a limitation.

**Implications for Practice**

Given the results and limitations of this study, some recommendations can be given for future studies. Training sessions could be conducted in combinations of structured and natural environments. During instruction, the personalities of participants and the features of target skills should be considered when selecting the implementations. This study was conducted one-on-one but small groups could be effective. This study was conducted with high-functioning children with ASD children, which could be compared to lower functioning children with ASD. Generalization data of this study were not collected in natural settings, which could be done in future studies. Play activities were carried out in a separate room while future studies could be conducted in classrooms or a natural game area. This study used Twister, Cricket, and a road construction game, but future studies could use different games. This study was conducted with researchers in clinical settings but could be repeated with different rewards in participants' homes. Future studies could analyze problem behaviors, include cost analysis, collect social validity data. This study included single-step skills, future studies could teach chained skills. The study was conducted with CTD arrangements; future studies could use other ETMs.

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