

The Comparison of Errorless Learning and Discrete Trial Teaching to Teach Adaptive Skills in
the Current Literature

by

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Submitted in Partial Fulfillment of the Requirements

for the Degree of

Master of Science

in the

Applied Behavior Analysis

Program

YOUNGSTOWN STATE UNIVERSITY

May, 2022

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ABSTRACT

Adaptive skills are a vital part of life and having the ability to complete adaptive tasks has the potential to increase an individual's independence throughout their lifetime. Within the field of applied behavior analysis (ABA), there are 2 teaching procedures that can be used to teach such skills: discrete trial teaching (DTT) and errorless learning (EL). While both are used in instruction, they differ in their approach. DTT allows clients to respond during training. If the client responds incorrectly the error correction procedures is used. Conversely, EL uses prompts during teaching to reduce the number of incorrect responses on the part of clients. These prompts are faded over time until clients respond correctly on their own. The purpose of this study was to complete a systematic review of the current literature and determine what teaching procedure, discrete trial teaching (DTT) or errorless learning (EL), is most effective in teaching adaptive skills to adolescents. No studies directly comparing the two were found. The researchers selected this topic to study because there are client's that need to learn adaptive skills to increase their independence. However, the most effective teaching procedure is unknown for these client's. Results indicated that the current literature is sorely lacking in the comparison of DTT and EL to teach adaptive skills. These findings suggest that further research is needed to identify which teaching procedure is best for teaching adaptive skills to individuals with ASD, which is important for therapeutic outcomes.

Keywords: *autism spectrum disorder, adaptive skills, discrete trial teaching, errorless learning,*

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The Comparison of Errorless Learning and Discrete Trial Teaching to Teach Adaptive Skills in the Current Literature

Applied behavior analysis (ABA) is the science of learning and behavior applied to problems of social significance (Leaf et al. 2021). ABA has been shown to be an empirically valid treatment methodology for education and behavior management (Alves et al, 2020). Applied behavior analysis is a scientific approach where interventions are implemented in a systematic way to modify socially significant behaviors (Yu, et al. 2020). ABA is used to treat various things. A few different skills that can be taught using ABA are self-care skills, communication, daily living skills, academics, and social skills (Al-Khateeb 2021). According to Ivy & Schreck (2016), ABA is an evidence-based research practice for individuals with autism. It has been shown to be the most effective treatment method used for autism spectrum disorder (ASD).

Autism Spectrum Disorder

ABA is most commonly used for individuals who have a diagnosis of autism spectrum disorder (ASD). ASD is a neurodevelopmental disorder that affects an individual's communication, behavior, and social skills (van't Hof et al. 2021; Hodges, Fealko, & Soares 2020; Frith & Happé 2005). ABA is effective in reducing symptoms of ASD (Smith, Groen & Wynn 2000; Lovaas 1987; Vietze & Lax 2020). Although ABA is effective for treating symptoms of ASD, it is not a cure for the disorder (Williams 2021; Deitz 1978).

Once an individual is diagnosed with ASD they will have it for the rest of their lifetime (van't Hof et al. 2021; Dietz, Rose, McArthur, & Maenner 2020). Individuals with ASD sometimes have shorter lifespans and have premature mortality (Cassidy et al.

2014, Hirvikoski et al. 2016). According to Croen and colleagues (2015) individuals with ASD have significantly increased rates of various psychiatric disorders including suicidal attempts. This correlates with a study conducted by Paquette-Smith and colleagues (2014) that found that individuals diagnosed with ASD, on average, have a shorter lifespan due to these suicidal attempts. According to previous research having adaptive and vocational skills will increase an individual's independence and decrease the supports they require throughout adulthood (Cakir et al. 2020; Jacob et al. 2015) which in turn increases an individuals' life span. A few things that can increase the quality of life for these individuals with ASD are gaining the skills that are used throughout adulthood (Clary et al. 2016). These skills include both vocational and adaptive skills.

Adaptive skills are skills that a person uses to function in their daily life such as communicating with others, and daily living tasks such as feeding oneself (Woodman et al. 2018). Most studies on teaching adaptive skills focus heavily on adolescents with ASD (Palmen, Didden, & Lang 2012). Previous research has shown that lower functioning individuals that are diagnosed with ASD typically have more deficits in adaptive behavior (Matson et al. 2012). Having the ability to complete adaptive tasks such as dressing and bathing themselves can be seen as a behavior cusp for individuals with ASD. A behavior cusp is a behavior that is intended to lead an individual to new reinforcers and new environments (Boudreault & Lessard 2020). For example, a child learning echoics will result in a faster tact response acquisition than shaping individual tact responses (Fryling et al. 2020; Lanter & Singer-Dudek 2020; Belisle 2020; Lovaas 1977).

Adaptive Skill Training in ASD Treatment

As mentioned, adaptive skills are a vital part of life and having the ability to complete adaptive tasks has the potential to increase an individual's independence throughout their lifetime. Typically, adaptive skills training starts in adolescence for individuals with ASD and other developmental delays to help them prepare and get ready to transition to adult life (Smith et al. 2012). Interventions based on the science of ABA have a large empirical base for working with individuals with ASD and other developmental delays (Ho et al. 2021; Alves et al. 2020; Linstead et al. 2017; Granpeesheh et al. 2009). Linstead and colleagues (2017) investigated different intensity and duration of ABA and its effect on learning different skills. They investigated different skills such as adaptive skills, academic skills, cognitive skills, executive functioning skills, language skills, motor skills, play skills, and social skills. The intervention was delivered by trained behavior therapists. They conducted both DTT and natural environment training. For the language part of the study, they used a verbal behavior approach. Errorless and least to most prompting was used in combination with reinforcement, chaining, shaping, and generalization training. Assessments, training and supervision was implemented regularly. Results from this study suggest that the intensity and duration of ABA has a direct effect on the acquisition of various skills including adaptive skills. It expands on existing research stating that ABA is an effective treatment for individual diagnosed with ASD. According to previous research conducted by Granpeesheh and colleagues (2009), ABA interventions such as prompting, shaping, chaining, discrete trial teaching, fading, and reinforcement have shown to be effective in teaching adaptive skills. They go on to explain how the development of these skills

increases an individuals' independence. To help gain independence as an individual with ASD ages, there are different teaching methods used to help these individuals acquire new skills. Examples of adaptive skills taught in the ABA literature include but are not limited to leisure skills, self-help skills, self-care skills, independent living skills, hygiene skills, and feeding skills (Matson et al. 2012). In sum, ABA interventions used to teach adaptive skills are effective.

Instructional Methods in ABA

There are different methods of teaching in the ABA literature that can be used during instruction. ABA techniques focus on understanding the function of behaviors, changing behaviors, and teaching new skills. According to Leaf et al. (2017), a few procedures that are often used in ABA consist of discrete trial teaching, prompting, incidental teaching, token economies, response cost, differential reinforcement, time-out from reinforcement, shaping, behavioral skills training, functional communication training, and chaining. These different teaching methods can be implemented at an individual's home, at school, and in the community in one-to-one teaching or group instruction formats. According to research conducted by O'Neill and colleagues (2018), different teaching methods are used to enable learners to better function across various environments. Different teaching methods in ABA can be used to meet the needs of each unique individual. According to Grob and colleagues (2019), anytime you teach a new skill, the instructional methods should include verbal explanations, modeling, and role-play with feedback. They found that a combination of methods would produce the greatest results. Two methods of instruction, discrete trial training, and errorless learning, will be the focus of the current study and will be reviewed.

As mentioned, many individuals with developmental disabilities such as ASD have deficits in adaptive skills (Fenton et al. 2003; Kanne et al. 2011; Paul et al. 2004; Tomanik et al. 2007; Tsermentseli et al. 2018). ABA therapy has been shown to be effective for teaching individuals with ASD adaptive skills (Smith et al. 2000; Lovaas 1987; Vietze & Lax 2020). Some individuals with ASD are taught skills in different ways in ABA therapy. These teaching methods include but are not limited to errorless learning (EL) and discrete trial teaching (DTT). In EL, participants are shown the correct response via prompts from the instructor, and these are gradually faded out across time to reduce or eliminate many of the errors that occur during standard error correction (Poolton et al. 2005). After the prompts are faded, it is expected individuals will exhibit the skills independently. Conversely, DTT teaches by allowing individuals to make a response after an instructor directive, with reinforcement for correct responding or correction for an incorrect response occurring after. The main difference between the two is that EL does not allow for as many errors to be made by learners as often as DTT procedures do. Previous research has been mixed as to which intervention is most effective (Blair et al. 2018; McKay et al. 2014; Leaf et al. 2020; Carroll et al. 2015; Leaf et al. 2014a; Schilmoeller et al. 1979). A more in-depth review of DTT and EL follows below.

Discrete Trial Teaching

Discrete trial teaching (DTT) is the most commonly used teaching method in ABA (Leaf et al. 2016). DTT is a systematic approach for teaching individual's new skills. In DTT, the therapist presents instructional materials, provides a directive, and allows the child to respond. If a correct answer occurs, reinforcement is provided. If an incorrect answer occurs, an error correction procedure occurs in which the therapist

represents the trial and prompts the client to make the correct response. Afterward, the trial is presented again to allow the child to independently make the correct choice. For instance, staff might tell a client to “touch flashlight” and if the child responds correctly and touches the flashlight, reinforcement is provided. If the child responds incorrectly, the therapist will represent the directive (“touch flashlight”), provide a prompt for the correct response (i.e., gesture to the flashlight), and then reinforce the correct prompted response. After that is complete, the entire trial is represented allowing the client to respond on their own without prompting (See Figure 1). While DTT does have a large empirical base (e.g., Sigafos et al. 2019; Eikeseth et al. 2014; Isenhower et al. 2018; Downs et al. 2008; Booth & Keenan 2018; Gongola & Sweeney 2012; Ali & Fazil 2022; Ferguson et al. 2020), it does allow for clients to make errors throughout the training which can require extra time to complete the error correction sequence outlined above. The errors can be associated with negative emotional responses or frustration (extinction induced behaviors) on the part of clients receiving services.

Ferguson et al. (2020) used a DTT procedure to teach communication skills, a type of adaptive skill, to adolescents with ASD. In their study, the researchers looked at the effects of discrete trial teaching and feedback to teach tact relations to children with ASD via telehealth. The study consisted of probes, intervention, and maintenance phases. Probes were collected during the baseline and maintenance phases. The intervention was a combination of a teaching session and a probe session. This was done twice a day for every weekday. The probes were conducted before the intervention or teaching session began. Once mastery was met, the participant was required to do the learning sessions

until all other participants had met mastery. Results indicated the DTT was effective and efficient for teaching tact relations via telehealth to all participants in the study.

Byra and colleagues (2018) use DTT to teach receptive identification. Authors discuss how there has been very limited research on teaching bathroom hygiene skills to children with ASD. Byra and colleagues investigated the effects of simulation and correspondence training on the acquisition of hygiene skills after bowel movements. There were only two participants ages five and six years old. The trials were conducted at a clinic. In the baseline phase, the parents of the participants determined if they successfully performed the task. The task was defined as the participants properly cleaning themselves after they have had a bowel movement. During the intervention, they completed a four-phase vocal prompt fading sequence. In the first phase, a card was held up and a vocal SD was given that asked if it was clean or dirty. A prompt was used to indicate whether the card was clean or dirty. The clean and dirty card was rotated for four trials and on the fifth trial, the prompt was removed to allow for an independent response. The next phase in the intervention was the receptive identification phase. During this phase, the participants were given an array of three cards and asked to touch the (clean, dirty, or blank) cards. Most-to-least prompting methods were used during this phase. The next phase used simulation training. It used a chaining script that the instructor read to the participant. A doll was used to indicate clean or dirty. There was a special kind of SunButter used to indicate dirty. Praise was given to the participant for completing each step in the chain. After mastery, a generalization phase was implemented. The parents did the generalization phase at home when the child had a bowel movement. The parents had to go off the hygiene protocol that was implemented by the instructors throughout the

intervention. The results indicated that the procedure used was effective in teaching the children how to properly wipe themselves after having a bowel movement.

Errorless Learning

Errorless learning (EL) is another systematic approach for teaching individual's new skills in the field of ABA. In EL, however, participants are shown the correct response via prompts from the instructor during instruction, and these prompts are gradually faded out across time. This is to reduce or eliminate many of the errors (hence the name errorless) that occur during standard DTT while eventually allowing for independent responding. For instance, in EL, a staff might tell a client "touch flashlight" and immediately point to the flashlight as a gesture prompt which is likely to facilitate a correct response from the participant. Reinforcement would immediately follow this response. Over time, the prompts are faded out and the client should begin responding to the original directive itself (see Figure 2). For instance, the therapist might wait longer to prompt, change the type of prompt, or use a less intensive version of a prompt (Gerencser et al. 2018; Cariveau et al. 2020). Errorless learning also has empirical support (Braga-Kenyon et al., 2017; Shillingsburg et al. 2020).

Braga-Kenyon and colleagues (2017) used EL procedures to teach visual conditional discriminations to typically developing children and children with ASD. In their study, they conducted pre-experimental phases and a training phase. During the pre-experimental phase, the discriminative stimulus (SD) was presented on the computer screen and the experimenter said to look and told the child to touch the stimuli. Then a set of comparison stimuli were presented, and the experimenter instructed the child to touch the stimuli that were the same as the first. The simple discrimination without instruction

phase was conducted in the same way as the simple discrimination with instruction except the experimenter did not talk to the participants. There was then a color discrimination phase where colors were used as prompts. It was run as a match to sample. In the training phase, they conducted simple discriminations and conditional discriminations, and an errorless procedure. In the simple discrimination phase, the participants had to match a stimulus to a sample. There were three stimuli at the bottom of the screen and the target stimuli were at the top of the screen. This phase used a fading procedure. In the conditional discrimination phase, the stimuli were presented in the same way as the simple discrimination phase. In the errorless phase, a prompt procedure was used to teach the stimuli. The brightness of the colors was used as the prompt fading procedure. The results indicated the procedure was effective for reducing errors for all the participants in the study and effectively taught conditional discriminations.

Statement of the Problem

As mentioned, previous research has attempted to find what kind of teaching procedures are most effective when working with individuals diagnosed with ASD (Blair et al. 2018; McKay, Weiss et al. 2014; Leaf et al. 2020; Carroll et al. 2015; Leaf et al. 2014a; Schilmoeller et al. 1979). Conducting an investigation on teaching procedures is important will help promote positive outcomes. Specifically investigating the effectiveness of DTT compared to the effectiveness of EL to teach adaptive skills. Further research on the topic will help identify which teaching procedure is best for teaching adaptive skills to individuals with ASD, which is important for therapeutic outcomes (Leaf et al. 2020; Blair, Weiss & Ahearn 2018; Carroll, Joachim, St. Peter & Robinson 2015; Schilmoeller, Schilmoeller, Etzel & LeBlanc 1979). Thus, the purpose of

the current study is to evaluate the current literature on comparisons of EL to DTT across common ABA journals to determine what teaching procedure, DTT or EL, is most effective for teaching adaptive skills to adolescents.

Method

To address the research question, a systematic review of the literature was completed using specific search terms within popular ABA journals. The search terms used were: autism spectrum disorder, discrete trial teaching, errorless learning, and adaptive skills. The journals searched were: Journal of Applied Behavior Analysis, Behavioral Interventions, The Journal of Behavioral Education, Journal of Autism and Developmental Disorders, Research in Developmental Disabilities, and Behavior Analysis in Practice. There were no restrictions on the search database being used since specific journals were selected.

Search Process

A four-stage search process was utilized to search the literature for relevant articles. The first search consisted of a title search using the specified search terms above in pairs. The pairs used were autism spectrum disorder/discrete trial training, autism spectrum disorder/ errorless learning OR errorless teaching, autism spectrum disorder/adaptive skills, discrete trial training/errorless learning OR errorless teaching, discrete trial training/adaptive skills, and errorless learning/adaptive skills. No date restrictions were utilized. It was specified that the terms had to appear in the title of the article and the search phrase AND was used between each term. The second stage of search involved searching more specific terms with less restrictive usage restrictions. The terms errorless learning, discrete trial teaching, and comparison were searched throughout

the article text instead of only the title of the article. The term AND was used to pair each term, which was entered in a separate search box. The third phase utilized the phrase “Comparing Discrete Trials to Errorless Learning” throughout any part of the text in the specified journals. The phrase was entered on the first search line. The fourth and final stage was an exploratory search by the author in which the phrase “Comparing Discrete Trials to Errorless Learning” used in stage 3 was searched across all journals in the database within the previous 10 years (2011-2021). Stage 4 was conducted with no restrictions of the search database utilized within Youngstown State University’s available databases.

Inclusion and Exclusion Criteria

The articles selected had to meet a predetermined criterion. The participants in the articles had to be between the ages of 13 to 18 and have a developmental disability such as autism spectrum disorder. The articles had to use specific teaching methods, either errorless learning or discrete trial teaching, to teach the participants adaptive skills. The articles were grouped based on the Journal they were found in, then based on the results that were found. Articles were excluded if they did not use errorless learning or discrete trial teaching procedures, if the articles were not in the predetermined journals, and if the participants were not between the ages of 13 and 18. If the articles did not compare the two teaching procedures (discrete trial teaching, and errorless learning) it was also excluded.

Interobserver Agreement

Interobserver agreement (IOA) was completed between the author and another trained observer. Each observer reviewed the abstract for articles produced by the search

process reviewed above. Each indicated whether the article warranted formal review or did not meet inclusion criteria based off the information. The initial overall IOA data was 97 percent. The researchers agreed on initial rejection for 184 out of 189 articles. The researchers agreed on 0 out of 5 articles for further review (i.e., one observer stated 5 articles warranted further review. After the researchers discussed the inclusion criteria further the IOA was 100 percent for all studies produced using the search process identified above.

Results

In total, 189 articles were located using the search parameters in the current systematic review. The first stage of searching yielded a total of 14 articles with the specified search parameters. The second stage of searching yielded a total of 46 articles. The third stage of searching yielded 28 articles. The fourth stage yielded a total of 101 articles. None of the articles from the stage met the inclusion criteria of comparing DTT to EL when teaching adaptive skills to individuals with ASD. Reasons for rejection included studies not comparing DTT and EL, not examining adaptive skills, or participant ages not being between 13-18. No articles were located in other languages. One intervention, simultaneous prompting, was identified in some articles throughout the search but did not match the specific search terms that were required in this study (see below).

Discussion

The purpose of this study was to evaluate the current literature and identify articles that compared DTT to EL for teaching adaptive skills to adolescents. The results of the present study found that no articles within the search parameters compared DTT

and EL to teach adaptive skills. The current study expanded on previous research by Kurt (2011) which reported that more research is needed to determine the effectiveness of DTT, and EL. The current study also demonstrated that little research other than Leaf and colleagues (2017) has been completed on this subject. In a later article, Leaf and colleagues (2020) explained how error correction produced more independent correct responses than errorless learning to teach expressive labeling, but no research has been done on the effects of teaching different skills. It can be concluded that the current literature is lacking when it comes to the comparison of DTT and EL in general, as well as research on which is best to teach adaptive skills to adolescents with ASD.

Simultaneous Prompting

As mentioned, one similar (but not identical) procedure that did appear in some of the research results was simultaneous prompting. Per Aljohani and colleagues (2021), simultaneous prompting is when the therapist provides a prompt immediately following the SD. The learner then responds to the prompt, and reinforcement is provided for correct responding. Per Morse and Schuster (2004), “simultaneous prompting is a *relatively new errorless learning response prompting teaching procedure* that has been reported to be effective in teaching students with and without disabilities” (p. 1, italics added). Thus, it appears that some “newer” forms of EL have are being used in the literature but are being labeled differently by researchers. Obviously, this presents a barrier for researchers attempting to investigate EL procedures.

In their seminal paper, Bear, Wolf, and Risley (1968) discussed the technological dimension of ABA and how specifying specific interventions used was important. In their article, they stated that “technological here means simply that the techniques making up a

particular behavioral application are completely identified and described (p. 95). Clearly, the use of a different name for a procedure that is conceptually similar and/or based on traditional EL procedures is likely to prevent researchers from identifying examples of EL in the literature, which was the case in the current study. It is unclear how the results of the current study would have been changed had similar terms been utilized for these different procedures.

Limitations

Some limitations to the current study include the limited number of journals used. The researchers selected predetermined journals, and this inherently limits the search results that are obtained. Another limitation was the database that was used. The database was a part of the Youngstown State University library resources. It is possible other resource collections might have produced more results. The number of articles found was another limitation. Using the predetermined journals, search terms, and age requirements resulted in a limited number of articles. The last limitation was the age requirement of the participants in the study. The current study sought to examine DTT and EL interventions with adolescents. It's possible that research exists with adult consumers of services, but that was not the purpose of the current review. The search terms utilized and the method of combining search terms also limits the results. However, a large number of results were returned, indicating that the terms used did yield results, just not those the current study sought to find.

Directions for Future Research

Future research should expand the search criteria to different journals. This will increase the total number of articles found and allow the researchers to get a better look at

what the current literature holds. Extending the search parameter to include earlier years would allow for a basic framework of what has been conducted in the past. Similarly, the age of the participants within the search parameters could be expanded beyond adolescents between the ages of 13 to 18 to see if any more research exists on this topic in general. Lastly, and perhaps most importantly, other researchers should examine the similarities and differences between EL procedures that go by different names.

Researchers should also utilize conceptually systematic terminology when referring to interventions in the literature to avoid compartmentalizing of results, which reduces the dissemination of research results. Hopefully, this would promote more research and ultimately help identify which of the two procedures is more effective. This information would be of value to clinicians and consumers of services. Research on the relative effectiveness of DTT and EL for teaching adaptive skills would be especially valuable for individuals transitioning into adulthood.

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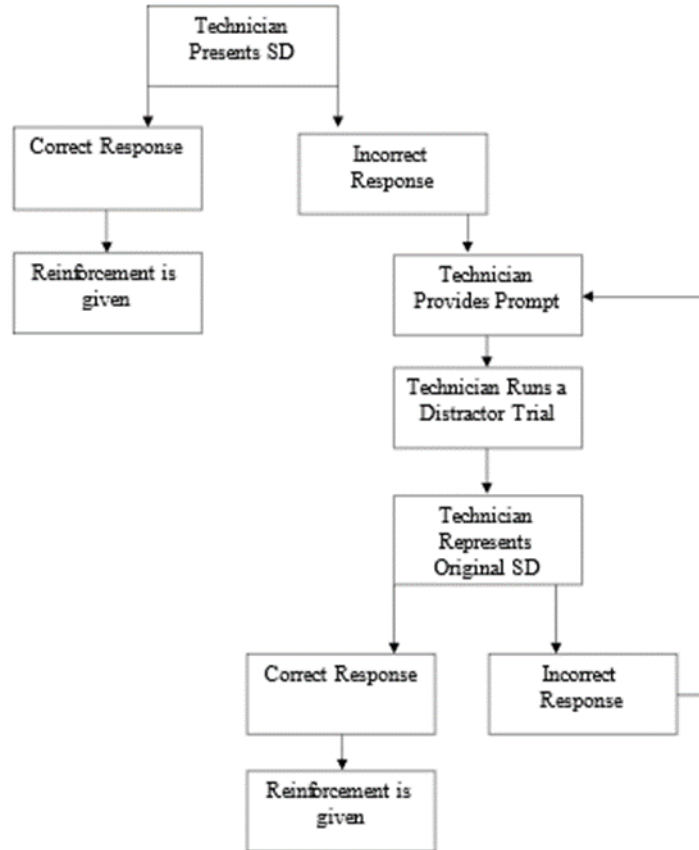
Figure 1*DTT With Error Correction Procedure*

Figure 2*Errorless Learning Procedure*