Behavior Analysis: Research and Practice
2017, Vol. 17, No. 4, 347–356


2372-9414/17/$12.00 http://dx.doi.org/10.1037/bar0000079

# Impact of Trial-Based Functional Analysis on Challenging Behavior and Training: A Review of the Literature

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Trial-based functional analysis (TBFA) uses a modified approach to traditional functional analysis (FA). The present review seeks to answer questions on outcomes of the assessment, procedures, data collection methods, graphical displays, and effectiveness of training. A review of the literature produced 17 studies that met criteria for inclusion. Results indicate that TBFA has the potential to effectively determine the function of challenging behavior. The use of TBFA allows for function-based interventions to reduce challenging behavior when traditional FA cannot occur. TBFA may also supplement additional assessment tools to help determine variables maintaining challenging behavior.

*Keywords:* trial-based functional analysis, functional analysis, training, challenging behavior



Functional analysis (FA) has provided many benefits to the field of applied behavior analysis. Most notably, FA has become an effective assessment tool to determine the environmental variables that maintain challenging behavior (Neef, 1994; Neef & Peterson, 2007). Functional analysis has seen iterations in its procedures throughout the years (see Hanley, Iwata, & McCord, 2003, for a comprehensive review). Current FA procedures mirror the work of Iwata and colleagues (Iwata, Dorsey, Slifer, Bauman, & Richman, 1994). The refinement of FA has led to the development of other types of assessments that retain many of the same procedures as FA (Betz & Fischer, 2011). Most notably, trial-based functional analysis (TBFA), a term developed by Sigafoos and Saggers (1995), introduces the use of brief sessions to determine function. The promise of TBFA lies in the ability to detect function of behavior without many of the more significant resources necessary for FA.

Since the publication of Iwata and colleagues seminal article, FAs have played a crucial role in the reduction of challenging behavior by uncovering environmental guidance of behavior (i.e., functional relations). The function maintaining the target behavior paired with an understanding of why someone behaves in a specific manner leads to increased use of reinforcement-based interventions (Pelios, Morren, Tesch, & Axelrod, 1999). Without the use of FA to determine function, a level of uncertainty would surround the effectiveness of procedures used to treat challenging behavior. For example, punishment procedures may still occur at high rates to reduce the challenging behavior without examining less-aversive alternatives. Generally speaking, FA has made significant contributions to the field of behavior analysis and helped numerous clients.

Although FA has many benefits, potential challenges remain. First, FA relies on exposing the participant to a dense schedule of reinforcement, which may temporarily increase the occurrence of the target behavior (Betz & Fischer, 2011). For example, reinforcing hitting for every instance of the behavior in a condition may result in a temporary increase of the behavior. Second, exposing the participant to a variety of reinforcing contingencies may engender a participant learning a new function that may not have maintained the target behavior prior to exposure (Betz & Fischer, 2011). A third challenge, some behavior should not receive manipulation in an FA (Neef & Peterson, 2007). Behavior that has severe physical consequences

This article was published Online First March 2, 2017.
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through repeated exposure, for example, would not lend itself well to FA procedures. Fourth, the expertise, time, and effort required to conduct and interpret FA create difficulties for practicing professionals (e.g., Sheridan, 2001). And fifth, FA requires systematic manipulations of the environment and do not always mimic conditions set in the classroom or other naturalistic settings (Lloyd et al., 2015). Coupled with the aforementioned time, behavior, and dense schedules of reinforcement considerations, the feasibility of conducting FAs for certain situations can pose difficulties for certain clients in need of effective intervention. However, these issues may not occur during all FA assessments.

TBFA uses specific antecedent and consequences in the participant's natural environment (Rispoli, Ninci, Neely, & Zaini, 2014). TBFA procedures take place during the course of a participant's day and present the environmental manipulations in a discrete manner. Data collection procedures rely on a percentage of occurrences and nonoccurrence of behavior in response to an antecedent manipulation to obtain a percentage (e.g., Sigafoos & Saggers, 1995). Experimenters examining the effects of trial-based functional analysis (TBFA) have reported promising results (e.g., Rispoli et al., 2014). TBFA addresses the limitations of FA through a variety of differences. Shorter condition durations limit exposure to reinforcement contingencies that could maintain challenging behavior (Betz & Fischer, 2011). A single professional can conduct the assessment during a participant's regularly scheduled day (Lloyd et al., 2015).

As a benefit, TBFA addresses many of the practical problems associated with FA, while retaining the important features necessary for detecting function. The core components of FA that overlap with TBFA include motivating operations, conditions, and level as a tactic of analysis. Motivating operations create an increased value of a reinforcing stimuli or a behavior altering frequency (Laraway, Snycerski, Michael, & Poling, 2003). Once a motivating operation has been established, a test condition takes place and the length of the conditions varies depending on the occurrence or nonoccurrence of the target behavior (Rispoli et al., 2014). Lastly, the level of behavior, or the average rate of responding, appears in both assessments as a means to determine function (Betz & Fischer, 2011).

Previous literature supports the argument for further research regarding the use of TBFA; moreover, refinement of the method could benefit the practicing behavior analyst or school professional (Lloyd et al., 2015; Rispoli et al., 2014). Further examination of TBFA would help provide further clarification on the effectiveness of the assessment as well as potential pitfalls. For example, practicing behavior analysts should remain aware of the possibilities of false positive results (Rispoli et al., 2014). Furthermore, behavior analysts may need to consider that TBFA may not have the same reliability as FA but could provide benefits compared to other types of assessments (e.g., indirect and direct observation) or applying a randomly selected intervention. Problems associated with indirect and direct observations include unreliability in the data and difficulties standardizing (Mace, 1994). Such limitations make TBFA a potential alternative to traditional FA procedures.

The present review seeks to investigate the effects of TBFA as an assessment to determine a functional relation. Furthermore, some experimenters have made a comparison between TBFA and traditional FA, as well as the ability for practitioners to conduct the assessment. Examining the effects of procedures, data collections, graphical displays, and training outcomes shed light on the utility of TBFA as an assessment tool. The questions this review seeks to answer include the following: What outcomes did TBFA produce? What procedures have been identified as an effective way to conduct TBFA? What data collection methods did experimenters use? What types of graphical displays appeared in the studies that met criteria for inclusion? And can education professionals (e.g., teachers) and behavior analysts in training receive instruction to conduct TBFA?

## Method

The search results from the literature on TBFA included studies published between 1982 and 2015. The selection of the year 1982 marks the publication of the seminal article "Toward a Functional Analysis of Self-Injury" (Iwata et al., 1994) demonstrating the effectiveness of functional analysis and outlined the procedural

guidelines for current practice. The search process consisted of two steps: a computer-generated search of the literature base and an ancestral search.

The electronic search included key-word searches of the Google Scholar, Proquest, EBSCO, and ERIC databases. Search terms included *trial based functional analysis*, *discrete trial functional analysis*, and *brief functional analysis*. In addition, the search term *FA* had replaced functional analysis in the aforementioned combinations. Only studies published in peer-reviewed journals met inclusion criteria. An initial search produced 12 studies and an ancestral search produced an additional 3. Two additional manuscripts met inclusion criteria after reliability had been conducted. The 17 studies included in the present review appeared in a variety of educational, psychological, and behavior analytic journals.

Studies in the present review focused on three aspects of TBFA. First, experiments that conducted a trial-based functional analysis and then implemented an intervention-matching function of the challenging behavior met criteria for inclusion. Second, studies comparing the results of TBFA to traditional functional analysis also met inclusion criteria. Third, experimental studies focusing on teacher training and implementation of trial-based functional analysis fulfilled inclusion criteria. Additional requirements for article acceptance consisted of a graphical display of the data, conducting the analysis in the participant's natural environment (e.g., classroom), and the target behaviors having an operational definition that could classify as a challenging behavior (e.g., aggression, self-injurious behavior). Studies focusing on academic learning problems, assessments occurring outside of the natural environment of the participant, other types of functional analysis (e.g., Precursor FA), or could not determine if the results of the TBFA matched the maintaining condition did not meet criteria for review.

A second evaluator conducted a reliability check. The evaluator used the following search terms: *trial based functional analysis*, *discrete trial functional analysis*, and *brief functional analysis*. Furthermore, the second evaluator substituted "FA" to replace "functional analysis." The second evaluator located 14 manuscripts in the initial search and an ancestral search produced 3 additional manuscripts. Fifteen of the manuscripts located matched the primary authors' initial search; two manuscripts sourced by the second evaluator also met inclusion. The agreement between the second evaluator and the author resulted in 88%. The primary author and evaluator agreed on 15 studies for an inclusion, with the addition of two manuscripts that were not included in the initial search ($n = 17$). A total of 17 studies met inclusion for the present review.

## Results

The reviewed studies obtained from scholarly and peer-reviewed journals focused on behavior analysis, individuals with developmental disorders, and professionals who implemented TBFA procedures under the supervision of an experimenter. Only studies that implemented an intervention after conducting a TBFA, a comparison of results from a TBFA to another assessment method, and professional implementation/training of a TBFA procedure met inclusion criteria (Austin, Groves, Reynish, & Francis, 2015; Bloom, Iwata, Fritz, Roscoe, & Carreau, 2011; Bloom, Lambert, Dayton, & Samaha, 2013; Chezan, Drasgow, & Martin, 2014; Kunnavatana, Bloom, Samaha, & Dayton, 2013; Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013; Lambert, Bloom, & Irvin, 2012; Lambert, Bloom, Kunnavatana, Collins, & Clay, 2013; Lambert, Lloyd, Staubitz, Weaver, & Jennings, 2014; LaRue et al., 2010; Lloyd et al., 2015; McDonald, Moore, & Anderson, 2012; Rispoli et al., 2015; Rispoli, Davis, Goodwyn, & Camargo, 2013; Schmidt, Drasgow, Halle, Martin, & Bliss, 2014; Sigafoos & Meikle, 1996; Wacker et al., 1990).

### TBFA Outcomes

Eight studies implemented an intervention based on the results of a TBFA (see Table 1). All of the studies reported a decrease in challenging behavior during intervention ($n = 8$). The experimenters demonstrated a functional relation between the results of the TBFA and intervention matched to function. For example, Bloom and colleagues demonstrated a drop in level of challenging behavior once an intervention began. The drop in level of challenging behavior demonstrated the results of the TBFA correctly identified the environmental variables maintaining behavior.

Table 1
*Experimental Studies That Ran a TBFA and an Intervention*

| Study | Graphical displays of TBFA | Measure used in TBFA | Condition duration | Match to function |
|---|---|---|---|---|
| Austin et al., 2015 | Bar graph | Percentage of trials | 2 min, or until the occurrence of the target behavior | Yes |
| Bloom et al., 2013 | Bar graph | Percentage of trials | 2 min, or less per session | Yes |
| Chezan et al., 2014 | Bar graph | Number of trials | Up to 2 min, or until occurrence of the target behavior (condition specific) | Yes |
| Lambert et al., 2012 | Bar graph | Percentage of trials | 2- to 4-min sessions | Yes |
| Lloyd et al., 2014 | Bar graph | Percentage of trials | 1–2 min per trial | Yes |
| Schmidt et al., 2014 | Bar graph | Percentage of trials | 1- to 3- min sessions | Yes |
| Sigafoos & Meikle, 1996 | Bar graph | Percentage of trials | 2 min per condition | Yes |
| Wacker et al., 1990 | Equal interval graph | Percentage of interval | 10-min sessions | Yes |

*Note.* TBFA = trial-based functional analysis.

Four of the studies conducted a TBFA and an FA, or other method of assessment to determine if the function of the challenging behavior matched between procedures (Bloom et al., 2011; LaRue et al., 2010; McDonald et al., 2012; Rispoli et al., 2013). Three of the studies directly compared the results of a TBFA to an FA (Bloom et al., 2011; LaRue et al., 2010; Rispoli et al., 2013). Of the studies that compared TBFA to FAs a total of 22 comparisons appear across studies (see Table 2). Each study compared multiple TBFAs and FA results. For example, LaRue and colleagues had five comparisons of the two assessments for a total of 10 graphs. The TBFA matched function to the FA in 10 instances (45%). Rispoli and colleagues reported inconclusive results during an analog FA and detected function during the TBFA. Experimenters who matched function between TBFA and FA successfully established an agreement, but that does not indicate that the function of behavior matches with the agreement. FA assessment results indicate in what condition (or conditions) a behavior most frequently occurred. Agreement does not ensure that the challenging behavior and function match in the natural environment.

McDonald and associates compared the results of a TBFA to indirect and direct assessments. Experimenters distributed an indirect assessment to the classroom teacher. The experimenters then used a Webcam and ABC recording procedures to capture behavior in two environments (i.e., playground and classroom). During the TBFA the experimenters used a handheld camera to capture behavior. Each method produced a different outcome. The indirect assessment provided inconclusive results while the direct observation reported socially mediated attention. The TBFA assessment resulted in access to tangible.

Table 2
*Studies That Compare TBFA to Analogue Analysis*

| Study | Graphical display of TBFA | Measure used in TBFA | Measure used in FA | Matched function to analog analysis |
|---|---|---|---|---|
| Bloom et al., 2011 | Bar graph | Percentage of trials | Rate per minute | Yes ($n$ = 6)<br>Partial ($n$ = 1)<br>No ($n$ = 3) |
| LaRue et al., 2010 | Bar graph | Rate per minute | Percentage of occurrence | Yes ($n$ = 4)<br>Partial ($n$ = 1) |
| McDonald et al., 2012[a] | Bar graph | Number of trials | N/A | No |
| Rispoli et al., 2012 | Bar graph | Percentage | Percentage | No |

*Note.* TBFA = trial-based functional analysis; FA = functional analysis; N/A = not applicable.
[a] McDonald et al. (2012) compared to indirect assessment and direct assessment.

## Trial-Based Functional Analysis Procedures

Trial-based functional analysis (TBFA) does not use a standardized procedure. However, the studies included for review do have commonalities and differences. The similarities have four main features. First, sessions occurred in the participant's natural environment (e.g., Bloom et al., 2013). Second, the conditions of attention, escape, tangible, and control, or a combination of them remained constant across studies (e.g., Lloyd et al., 2015). Third, sessions did not run consecutively. Fourth, experimenters mostly used discontinuous measures of behavior (see Table 1).

Differences include variations in session length across studies and differences in graphic displays (see Table 1). Although a standard does not exist for the use of graphic displays, the bar graph appears more frequently in the studies included for review (see Table 1). Experimental studies had a mean length of session of approximately 8 min (Austin et al., 2015; Bloom et al., 2013; Chezan et al., 2014; Lambert et al., 2012; Lloyd et al., 2015; Schmidt et al., 2014; Sigafoos & Meikle, 1996; Wacker et al., 1990). However, an instance of TBFA had a session length of 10-min, which mirrors more traditional FA guidelines (Wacker et al., 1990).

Differences existed when comparing TBFA procedures and other assessment types (e.g., traditional FA). The results of TBFA and FA experimenters used a percentage of interval and a rate per minute measure, respectively (Bloom et al., 2013; LaRue et al., 2010; Rispoli et al., 2013). The experimenters also displayed the TBFA data on bar graphs, while reporting FA data on nonstandard linear graphs (see Kubina et al., 2015, for a comprehensive review of nonstandard linear graphs).

## Data Collection

Data collection procedures varied across studies. Yet, nine of the studies did use percentage of occurrence to measure behavior in some capacity during assessment (see Tables 1 and 2). Of the studies that implemented an intervention based on the results of a TBFA, two used a count per unit of time measure during intervention (Bloom et al., 2013; Lambert et al., 2012). In studies that compared a TBFA to another assessment, two used a count per unit of time for traditional FAs and one used a number of instances for direct observation (Bloom et al., 2011; LaRue et al., 2010; McDonald et al., 2012). Lloyd et al. (2015) displayed presence and absence of behavior during the TBFA and intervention phases. TBFA primarily uses a percentage (i.e., percentage of intervals), while intervention or comparison assessments measure using a count per unit of time or count metric. Professional training studies relied on measuring behavior only using percentage correct.

## Graphical Displays

Across studies a total of 49 individual TBFA assessments used visual displays (Austin et al., 2015; Bloom et al., 2011, 2013; Chezan et al., 2014; Lambert et al., 2012; LaRue et al., 2010; Lloyd et al., 2015; MacDonald et al., 2012; Rispoli et al., 2013; Schmidt et al., 2014; Sigafoos & Meikle, 1996; Wacker et al., 1990). Of the 49 individual TBFA results published, 39 displayed data on a bar graph (89%). The remaining 10 TBFA results appeared on nonstandard linear graphs. Experimenters included multiple data sets per manuscript. The nonstandard linear graphs primarily used a multielement design, with the exception of one (Wacker et al., 1990). Wacker and colleagues used an alternating treatment design for two participants and a reversal design for another participant.

The remaining studies displayed data on tables, line graphs, and bar graphs (Kunnavatana, Bloom, Samaha, & Dayton, 2013; Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013; Lambert et al., 2013, 2014; Rispoli et al., 2015). The studies used tables to display participant characteristics, line graphs to measure correct implementation of steps, and bar graphs to measure accuracy in graphing.

## Professional Implementation of TBFA

Teachers/paraprofessionals, teachers' support staff (i.e., program coordinators), graduate students, or residential facility staff members implemented TBFA in the studies that focused on training (Kunnavatana, Bloom, Samaha, & Dayton, 2013; Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013; Lambert et al., 2013, 2014; Rispoli et al., 2015). A total of 43 participants appeared across studies. Thirteen of the participants worked as teachers or paraprofessionals. Five participants held employment

as coordinators that worked in conjunction with teachers. Fifteen participants worked in residential facilities. Ten of the participants had enrolled as graduate students in an applied behavior analysis degree program (see Table 3). Of the 43 participants, 10 obtained a high school diploma or GED equivalent. Two participants held an associate's degree. Seventeen participants held a bachelor's degree and 14 held a master's degree. Additionally, three participants had board certification as a Board-Certified Behavior Analyst ($n = 2$), or Board-Certified Assistant Behavior Analyst ($n = 1$). Experimenters successfully trained professionally to conduct TBFA across studies, indicating that the assessment does not require the same expertise as does traditional FA (Kunnavatana, Bloom, Samaha, & Dayton, 2013; Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013; Lambert et al., 2013, 2014; Rispoli et al., 2015).

## Discussion

Behavior analysts using TBFA have accurately determined the function of challenging behavior. Although differences did exist between TBFA and FA in graphical displays (see Table 2) and procedures, results demonstrate that the assessment addresses potential problems in FA methodology. Furthermore, TBFA training studies have shown that education professionals can implement the assessment in their classrooms (see Table 3). TBFA addresses the issues of time, space, and expertise to conduct the assessment.

### TBFA Outcomes

Experimental studies revealed a functional relation once an intervention began, verifying that an in-situation assessment of challenging behavior can provide meaningful results (Austin et al., 2015; Bloom et al., 2013; Chezan et al., 2014; Lambert et al., 2012; Lloyd et al., 2015; Schmidt et al., 2014; Sigafoos & Meikle, 1996; Wacker et al., 1990). TBFA has many potential benefits for participants. The ability to determine function in the participant's natural environment makes the use of the assessment accessible to education professionals. Using these results allows for the development of function-based interventions that provide long-lasting behavior change. TBFA demonstrates that in certain situations, the assessment offers a feasible alternative to situations where a traditional FA would pose problems.

While the assessment shows meaningful results, training others to implement TBFA can occur in short durations and through different methods. Professionals can learn how to conduct a TBFA in a relatively short amount of time (Kunnavatana, Bloom, Samaha, & Dayton, 2013; Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013; Lambert et al., 2013, 2014; Rispoli et al., 2015). Training other professionals to implement TBFA allows a behavior analyst the ability to disseminate an effective assessment and through a variety of mediums. The dissemination of TBFA helps with implementation of function-based interventions, as education professionals would not have to guess as to what is maintaining the behavior. Additionally, training can occur through multiple

Table 3
*TBFA Studies That Focused on Training of Education Professionals*

| Study | Participants | Method of instruction | Mean years working in special education | Duration of intervention |
|---|---|---|---|---|
| Kunnavatana, Bloom, Samaha, & Dayton, 2013 | Special education teachers | In service | 7 years, 9 months | 26 sessions |
| Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013 | Coordinators and teachers | In service, in situation | 13 years, 1 month | 24 sessions |
| Lambert et al., 2013 | Residential staff | Role play, in situation | Not specified | 30 sessions |
| Lambert et al., 2014 | Graduate students | Training in university setting | 0 years | 40 sessions |
| Rispoli et al., 2015 | Head Start | In service | 5 months | 22 sessions |

forms allowing for flexibility-based on individual circumstances.

### Trial-Based Functional Analysis Procedures

Short-duration conditions produced measurable behavior. In other words, condition duration demonstrated the same results in FA using 15-, 10-, or 5-min sessions (Betz & Fischer, 2011). The shorter length of conditions allows less reinforcement of the challenging behavior than longer sessions. Commonalities across studies included sessions conducted in the classroom, short sessions (i.e., <10 min). The short session duration demonstrates that a functional relation can appear quickly.

Furthermore, procedures took place in the participant's natural environment (Austin et al., 2015; Bloom et al., 2013; Chezan et al., 2014; Lambert et al., 2012; Lloyd et al., 2015; Schmidt et al., 2014; Sigafoos & Meikle, 1996; Wacker et al., 1990). The use of the natural environment created opportunities to conduct sessions during the participant's day and did not involve removal or modification of schedule. The ability to test for function in such a manner minimizes risk of exposing the participant to a reinforcing consequence in an isolated room. For example, a practitioner may learn that the challenging behavior produces reinforcement for attention in an isolated setting and the participant may attempt the behavior in another setting.

### Graphical Displays

Graphical displays assist visual analysis with decision making. Traditional FA typically reports data using line graphs (e.g., Neef, 1994). TBFA uses line graphs and bar graphs (see Table 1). The bar graphs appear to have the same effect in regards to decision making. Bar graphs have an important implication for TBFA. Bar graphs lack the ability to detect sequencing effects in the data. Experimenters need to account for the possibility of sequencing effects in their procedures. Motivating operations (MOs) establish the value of behavior and condition sessions should consider the appropriate interval to establish value. However, determining the duration between sessions would require consideration on an individual basis.

Line graphs have acted as a standard practice in the display of data in the field of behavior analysis. Experimenters did not have agreement when comparing the results of a TBFA and traditional FA (see Table 2). The lack of agreement between graphs could occur due to the ability to see carry over effects on line graphs and controlling for MOs procedurally. However, since TBFA relies on level as a decision-making tactic, behavior analysts could consider that examining level in the bar graph display as a clearer method of visual analysis. Professionals should also consider that without an intervention based on the results of TBFA, it could not be determined if the assessment detected the correct function.

### Data Collection

The measurement systems used in visual analysis provides varying types of information. For example, using rate provides a count across time. Therefore, the data collection used must provide the best information as possible to determine function. Additionally, practitioners must have a data collection system that provides accurate information. If data provide inaccurate information, an incorrect decision could follow. Experimenters largely relied on percentage of occurrence to determine function (see Tables 1 and 2). The studies that used a percentage of occurrence or nonoccurrence measure did determine a match to function, however; the use of a discontinuous measure may have more difficulty with multiply-maintained or undifferentiated results. The benefit of discontinuous measures includes ease of collection by the person conducting the assessment and function can be determined in most results (see Tables 1 and 2).

### Professional Implementation of TBFA

Persons charged with conducting TBFAs held a wide range of positions (Kunnavatana, Bloom, Samaha, & Dayton, 2013; Kunnavatana, Bloom, Samaha, Lignugaris/Kraft, et al., 2013; Lambert et al., 2013, 2014; Rispoli et al., 2015). However, results demonstrated that all professionals had the ability to conduct a TBFA after training. The ability to conduct a TBFA with an experienced professional

makes practical application of TBFA more likely to occur. The ability to learn to conduct the assessment gives education professionals the ability to develop a function-based intervention. Furthermore, experimenters demonstrated that professionals do not need a large amount of training to conduct TBFA. Education professionals need an effective method to determine function of challenging behavior that does not require time-intensive training.

## Limitations of Studies

Studies included for review examined various aspects of TBFA. With regards to studies that implemented an intervention after conducting a TBFA, experimenters implemented relatively long condition durations (e.g., Wacker et al., 1990). Speculation could exist that longer condition durations make teacher implementation more difficult and time consuming. Studies that compared TBFA to FA used different data collection procedures that may have manipulated judgment of the visual analysts (Bloom et al., 2011; LaRue et al., 2010; McDonald et al., 2012; Rispoli et al., 2013). For example, the inability to detect sequencing effects using visual analysis cannot occur with bar graphs. Although participants from the studies had a range of educational backgrounds, the sample did not have participants that represented all types of educators. Public school systems include children with challenging behavior and the contingencies in public school may vary from other environmental settings.

## Future Research

TBFA's ability to determine functional relations allows for a solution to individualized problems that may result with traditional analog assessment. More research is needed in training professionals to conduct TBFA. Additionally, examining the differences in outcomes between TBFA and FA should require more attention. FA research has benefited from structured criteria (Hagopian et al., 1997; Roane, Fisher, Kelley, Mevers, & Bouxsein, 2013). Structured criteria might provide assistance to those who may not have formal training in behavior analysis (e.g., teachers). Structured criteria have shown an increase in agreement between people with formal behavior analytic training.

Lastly, future research could focus on using a variety of graphical displays, data collection procedures, and session lengths. Graphical displays included in this review focused on bar graphs and nonstandard linear graphs. Other graphical displays may contribute additional benefits for analysis. Manipulating the presentation of the data (i.e., sequential and nonsequential) may provide more clarity in analysis.

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Received June 28, 2016
Revision received January 24, 2017
Accepted January 30, 2017 ■