MULTILEVEL MODELING OF BEHAVIORAL OBSERVATIONS OF HEAD START STUDENTS; ACCOUNTING FOR INITIAL CONDITIONS

By

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MULTILEVEL MODELING OF BEHAVIORAL MEASURES OF HEAD START STUDENTS; ACCOUNTING FOR INITIAL CONDITIONS

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Abstract: A sample of 101 Head Start students were repeatedly tested for behavioral improvements during a TCIT study. The measure used to test the students (the BOPS) had not previously been validated. Factor Analysis was used to determine the underlying structure of the BOPS; a frequency-based observation tool used to measure challenging and prosocial behavior in preschool students. Parallel analysis and a scree plot were used to select the five factors retained from the Principal Axis Factoring (KMO=.768). The five factors retained accounted for over 62% of the variance. Three of the factors were prosocial in nature and two were challenging behaviors. Multilevel Model was used to demonstrate the nested nature of the students over multiple occasions in a classroom structure. Variance components were significant ($p<.001$) and the ICC=80.18%, indicating that the nested model was appropriate. The time variant model was significantly better than the null ($\chi^2(2)=56.73$, $p<.001$).

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CHAPTER I

INTRODUCTION

Parent-Child Interactive Therapy (PCIT) is a well-known method of teaching parents how to manage challenging behavior in young children (Lieneman, Brabson, Highlander, Wallace & McNeil, 2017). This method was later adapted to provide a technique for Head Start teachers to manage some difficult behaviors in their classrooms, called Teacher-Child Interaction Therapy (TCIT; Campbell, 2011; Lyon, Gershenson, Farahmand, Thaxter, Behling & Budd, 2009). The standard design is pre-posttest which describes the situation where participants are measured before and after treatment is administered (Barnett, 2017). A common method of analysis for this design is repeated measures analysis, which assesses significant differences in observations gathered on the same individuals over time. Each individual contributes to the mean and the comparisons at pre and post are mean comparisons. It does not distinguish between the individual changes and the group or classroom changes. Specifically, in the case of TCIT, the variability in the group or classroom is mixed with the variability in the individual student.

Multilevel modeling (MLM) is a type of analysis that allows statistical parameters to vary at more than one level. This allows for statistical modeling of the students in context of the classroom and the student's behavior in context of the student (Hoffman & Stawski, 2009). A benefit of MLM over traditional repeated measures is that it offers a unique approach to accounting for the changes within classrooms as well as within students over time. One purpose

of this study is to compare the applications of repeated measures analysis and MLM in order to determine if the MLM procedure may offer a clearer picture on how helpful TCIT teachers and students.

TCIT is an adaptation of PCIT (Campbell, 2011; Lyon et al., 2009). The goal of the techniques is to work with parents and teachers to identify problem behaviors and give the tools to respond in a more productive way in order to lower the frequency or severity of the behavior. Problem behaviors include (but are not limited to) aggressive behavior toward adults or peers, noncompliance, defiance, or encouraging disruptive activities (Campbell, 2011).

Measuring Behavior

There are multiple validated surveys available to measure the success of the therapy, such as the Eyberg Child Behavior Inventory (ECBI), Sutter-Eyberg Student Behavior Inventory (SEBI), and the Child Behavior Checklist (CBCL). Those surveys are made for the parent or teacher to complete. The results of the survey could be parental response bias, or the "halo effect," but still yield consistent pre-posttest results as well as significant differences in behavior problems as a response to treatment (Robinson, Eyberg & Ross, 1980). All of the available measures are Likert-type scales with a list of challenging behaviors listed and choices such as "often," "average," or "never." Typically, the surveys are complete before and after treatment (Lieneman et al., 2017).

A new measure, the Behavioral Observations of Preschoolers System (BOPS), was created to focus on all observable behaviors, whether desirable or undesirable, and account for anything a student could be doing while being observed (C. Campbell, personal communication,

December 8, 2018). This measure is not a Likert-type scale completed by the parent or teacher, but a frequency-based measure completed by a trained research assistant. The frequency information provides the number of times each behavior was observed during the designated time as opposed to the previous measures which allow the rater to select of "often," or "average." These options are subject to interpretation by the person completing the survey. Further, the BOPS utilizes trained research assistants, reducing the "halo effect." It has interrater reliability of .85, but it has not been validated (Campbell, 2011). The other purpose of this study is to validate the instrument using factor analysis on a sample of 101 children from six Head Start classrooms in the Midwest. Validation of this measure will advance its uses and solidify the results in previous research.

Previous Research Designs

Research in PCIT and TCIT leans heavily on the customary pre-post test design to analyze the data (Barnett, 2017). Of the eleven articles assessed by Barnett (2017), all of them showed significant changes in behavior after TCIT. This design is grand mean centered and though it uses the participants as their own control and allows for dependent samples, it is not sensitive to the change from occasion to occasion in the participant behavior. McIntosh, Rizza and Bliss (2000) are recognized as the first researchers to transition PCIT to a teacher-student intervention. They reported a decrease in problem behaviors in a case study as well as a need for a standardized method or treatment manual to direct intervention (McIntosh, Rizza & Bliss, 2000). Multiple methods of TCIT are currently utilized, and there is a need to standardize the technique (Fernandez, Gold, Hirsch & Miller, 2015). TCIT is best as an early intervention and meets a previously unmet need: behavior management (Fernandez et al., 2015). Garbacz,

Zychinski, Feuer, Carter and Budd (2014) investigated the effectiveness of TCIT on children younger than preschool age and further support the method as a behavior modification technique that reduces challenging behavior, specifically in students with a higher baseline of challenging behavior. Kanine (2016) found TCIT effective in decreasing challenging behavior as well as increasing social emotional skills in children who had previously experienced maltreatment. The teachers in this study reported lower stress post treatment (Kanine, 2016). The researcher intensive training method involves the teacher practicing each skill in TCIT until mastery (Campbell, 2011). This method provided a decrease in challenging behavior in class and at home as well as an increase in teacher self-efficacy (Campbell, 2011). Teachers trained by staff and researchers showed a comparable decrease in challenging behavior, indicating a more practical approach of training could be implemented (Budd, Garbacz & Carter, 2016).

Additionally, it under-estimates changes in behavior attributed to treatment effects because some students have more behavior problems than others and see more improvement (Bulotsky-Shearer, Dominguez & Bell, 2012). Analyzing the participant behavior contextually, or with regard to the shared classroom space, but allowed to have its own prediction and person-centered variation, can show these child-level behavior changes as well as nested classroom level influences (Bulotsky-Shearer et al., 2012; Hofer et al., 2009; Hoffman & Stawski, 2009).

Research Questions

There are two primary research questions for this study:

- Is the BOPS a valid scale to measure student behavior?
- How well does a Multilevel Model explain the students' behavior over time?

Significance

The BOPS is a scale unlike any other available to measure behavior. It surpasses the ordinal variables assessed on other surveys, provides a less bias assessment of behavior, and includes all of the behaviors a child could engage in at any given time (Campbell, 2011). Validating this measure will make it more appealing to researchers for use in the future, as well as provide a foundation for its continued uses by the author.

An MLM analysis of this data provides a closer examination of the nested characteristics of classroom inclusion, i.e., students nested within classrooms, as well as the initial behavioral condition the students. It allows the teacher experience and pedagogical effects of that experience on the students to account for the variability in behavior. It also shows the effect of treatment on each student by modeling the fluctuation from occasion to occasion, demonstrating a student's variability around his or herown mean.

Conflict between the student and the teacher in early school years is a predictor of aggression during later years of primary school (Lee & Bierman, 2018). Children exposed to the combined risk of poor teacher-student interactions as well as adversity in the classroom demonstrate aggression and difficulty with social interactions in first grade (Lee & Bierman, 2016). There are also positive effects of a good Head Start experience. Achievement in Kindergarten readiness sets children up for success in later academic years (Graf, Hernandez & Bingham, 2016). The ability of students to maintain positive social relationships at this young age predicts future reading and math performance (Graf, Hernandez & Bingham, 2016). Long term positive effects of Head Start include an increased likeliness of completing high school and

attending college and a decreased in likeliness of criminal activity and charges (Garces, Thomas & Currie, 2002).

Improving child behavior is the specified interest in TCIT, but there are other benefits to consider at the classroom level. Teacher turnover in Head Start because of poor behavior is detrimental to student learning. Teachers' psychological wellbeing is positively affected when competence is improved (Garces, Thomas & Currie, 2002). Further, it is suggested that the changes be made at the program level. TCIT does this by coaching the teacher one on one, identifying behaviors and training methods to reduce disruptive ones (Campbell, 2011).

Assumptions

This research makes the assumption that there are children in Head Start with behavior problems. Further it assumes that the behavior problems vary in their initial condition from student to student. It is assumed that the BOPS was properly used by the research assistants and that their scores were accurate representations of the students' behaviors.

Limitations

Sample size is a limitation of this study. The initial selection was small and the loss due to attrition makes it a substantial limitation. Head Start requires certain teacher credentials above most preschool programs so the results of this study may not generalize to programs that have lower teacher qualification requirements. Experience was considered in years but not in education, which could be a factor in initial conditions of the students' behavior simply because of awareness of effective teaching methods. The demographics likely arising in the Midwest do

not accurately reflect all Head Start centers in the general population both in staff and student race, ethnicity and other demographic factors.

Summary

TCIT is a well-documented method for reducing challenging behavior in Head Start classrooms. The BOPS is a frequency-based measure of all behavior a child could be engaged in, both good and bad. Validation of this scale will make it accessible to other researchers currently using ordinal measures of behavior. MLM offers a unique look at the initial conditions of the individual students in the class as well as the pedagogical effects inherent to being in the same classroom. These two things combine will add to the body of empirical evidence supporting TCIT and offer new ways of measuring behavior and analyzing data.

CHAPTER II

LITERATURE REVIEW

Teacher-Child Interaction Therapy (TCIT)

Disruptive or undesirable behaviors may differ across scenarios, e.g., home and school, and there is not an established, universal set of these behaviors. The Teacher-Child Interaction Therapy (TCIT) provide a guide to teachers of "Do" and "Don't" skills when responding to a student's behavior (Campbell, 2011; McIntosh, Rizza, & Bliss, 2000). The "Do" skills describe things the teacher should do to reduce challenging behavior in the classroom. McIntosh, Rizza and Bliss (2000) describe these skills with the acronym DRIP: describe, reflect, imitate and praise. Conversely, the "Don't" skills are things the teacher should not do to maintain appropriate behavior in her classroom. McIntosh, Rizza and Bliss (2000) describe these "Don't" skills as follows: "don't give commands, don't ask questions, don't criticize, and ignore inappropriate behavior (unless dangerous or destructive)." TCIT differs from Parent-Child Interactive Therapy (PCIT) in implementation and intervention, the behaviors it targets are the same. An example of the difference between a PCIT approach and a TCIT approach is in how the participant would ignore behavior. Ignoring disruptive behaviors is a method used in both situations but because a teacher has a group of children and a parent-child is typically a dyad, the teacher will not only ignore the disruptive behavior, but also acknowledge the ideal behavior with labeled praise (Fernandez et al., 2015)

The goal in TCIT is to use coaching and real time feedback to improve the teacher's use of "Do" skills when interacting with her students (Campbell, 2011; McIntosh, Rizza, & Bliss, 2000). The goal is to keep interactions between student and teacher positive and build relationships. Research tends to focus on overactive disruptive behaviors, as compared to underactive behaviors, because it is easier to notice and more problematic (Bulotsky-Shearer et al., 2012). As previously discussed, TCIT reverses this teacher focus and increases positive interactions in the classroom while ignoring problematic behaviors (Fernandez et al., 2015).

Though TCIT is a relatively new approach with the first case study published in 2000, there are already a few variations on how to teach the skills to the participants. This study focuses on "in the moment" teaching of skills (Campbell, 2011). Alternatives would be more classroom training oriented, but those have shown to have less effectiveness in previous research (Barnett, 2017; Campbell, 2011).

Instruments for Measurement

Several instruments have been developed for measuring problematic behavior in children. Some are intended for parents (e.g., the Eyberg Child Behavior Inventory), some are intended to be administered by the teacher (e.g., Sutter-Eyberg Student Behavior Inventory), and others are for use of an external investigator (e.g., the Behavioral Observation of Preschoolers System [BOPS]). These are briefly explained to differentiate them from the BOPS, which is the primary instrument used in TCIT.

The Eyberg Child Behavior Inventory (ECBI).

Eyeberg and Ross (1978) used two years of data to compile a list of child behaviors, then assigned them each a scale from one to seven for scoring with a lower score corresponding to a less frequent display of disruptive or problematic behavior. The scale was designed to be used by parents to identify and assess frequency of problem behaviors. Means of the 36 items were around three, between "seldom" and "sometimes." Children were either measured once, before and after some treatment (Eyberg & Ross, 1978). Burns and Patterson (2001) gathered a very large sample size with a large range of ages and created a normative scale to use for comparison. The data offers an intensity score and a problem score; the first tells the frequency of the 36 behaviors and the second tells which behaviors of the 36 are present (Burns, & Patterson, 2001). The ECBI is designed to be used in conjunction with a behavioral measure (Robinson, Eyberg & Ross, 1980). In a validity study, they found that ECBL was not as good at distinguishing between internalizing and externalizing behavior as some other measures (Boggs, Eyberg & Reynolds, 1990).

Sutter-Eyberg Student Behavior Inventory.

The ECBI is a parent measurement tool, so it is not designed for a teacher rating. The Sutter-Eyeberg Student Behavior Inventory (SESBI) contains the same 36 behaviors but is more concerned with on and off task behaviors (Eyberg & Pincus, 1999). There are both short and long versions of this instrument using a Likert-type response scale that provides either eight or three factors representing social development and challenging behavior (LaFreniere & Dumas, 1996). This measure relies on teacher reports instead of observable behavior (McDermott, Rikoon & Fantuzzo, 2014).

Achenbach Child Behavior Checklist.

Developed in 1992 by Achenbach (1992), the Achenbach Child Behavior Checklist (CBCL) scale classifies students as deviant and was originally for children two to three years old. This 3-point Likert-type scale has different versions, the CBCL for parents and the Caregiver – Teacher Report Form (C-TRF) for caregivers and teachers (Achenbach & Rescorla, 2000). Instructions for measurement do not account for within and between subject changes. Also, it gives specific instructions on time intervals between measures and must use baseline or 2-month measure; anything in between gets classified as one of those two (Achenbach & Rescorla, 2000).

Behavioral Observation of Preschoolers System.

Campbell (2011) developed the 35- item Behavioral Observation of Preschoolers System instrument to "capture any activity the child could be engaged in at any time (C. Campbell, personal communication, December 8, 2018)." Unlike its predecessors, this measure is a real-time observation tool designed to be completed by a researcher or research assistant. This measure is currently used in Dr. Campbell's TCIT manuals and comes with high interrater reliability, but has not yet been validated (C. Campbell, personal communication, December 8, 2018). The first purpose of this research is to validate the BOPS on a sample of Head Start students. Validation of this instrument will give other researchers an alternative to teacher or parent Likert-type scales when evaluating child behavior.

Analysis of the Instrument

The second purpose of this research, in addition to validating the BOPS instrument, is to use a different analysis than is typical in previous research for behavioral interventions. TCIT was

initially designed for use in a clinical setting with generally more disruption than a typical classroom (Tiano & McNeil, 2006). It has been adapted as a standard model for classroom behavior management (Fernandez et al., 2015). This adaptation comes with analytic complications. In a clinical setting, the number of students with initial behavioral problems would likely be higher than a typical classroom; therefore, it stands to reason that the mean differences found by researchers are underestimating changes in problem students.

Pre-post analysis is the most common way of looking at behavioral differences in response to TCIT (Barnett, 2017; Lieneman et al., 2017). Though this analysis can account for multiple measures of the same student, it does not distinguish the variance accounted for within and between participants. A Multilevel Model (MLM) can be used to analyze the variability both between participants in a classroom and within each student's measurements (Lüdtke, Robitzsch, Trautwein, & Kunter, 2009). The distinction between a person in the class and within a person from occasion to occasion measure allows the within student change to be more apparent than it is in a classic pre-post test analysis where each person contributes to the mean regardless of their unique change (Hoffman, 2018). Hoffman (2018) suggests person mean centering to demonstrate fluctuation over time. This allows the variability to be partitioned as between person differences and within person differences.

In addition to the unique perspective that MLM offers to measuring the variability by student in the context of each classroom, it can also model the differences between classes. Because the data are sampled hierarchically, analysis that does not account for this nesting within classrooms can lead to biased standard errors and potentially an inflated effect estimate (Snijders & Bosker, 2012; Martinez, 2012; Opdendakker & Van Damme; 2000). Samples of students

within classrooms are naturally dependent because of their clustered nature, but often viewed as independent measures causing a violation of many analysis assumptions (Snijders, 2011). Modeling the classrooms in this way allows the pedagogical effects on behavior to be accounted for. Figure 1 displays the levels 1 and 2, and Figure 2 displays the levels 2 and 3. A three-level MLM that accounts for (1) classroom level variability, (2) individuals within the class, and (3) each individual's measure across time.

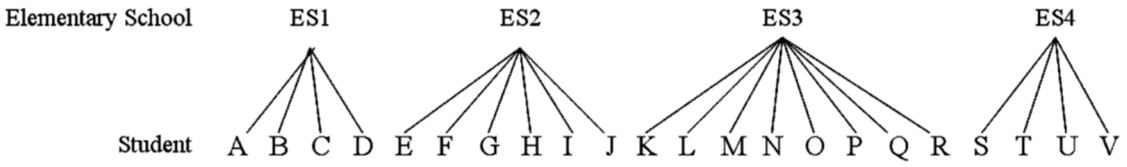

Figure 1. Representation of the nesting of students (A, B, C, etc.) within elementary schools (ES1, ES2, etc.).

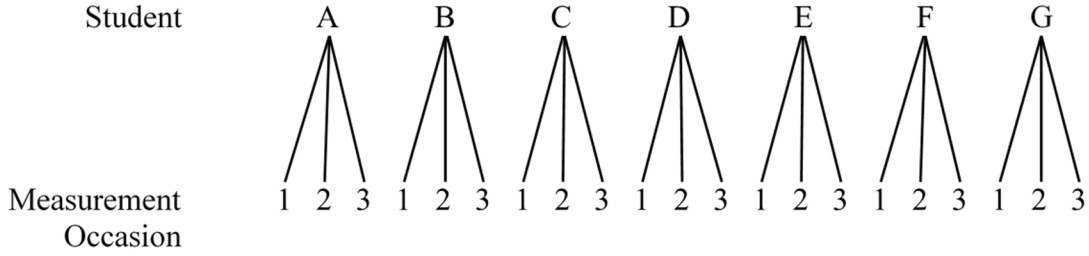

Figure 2. Representation of the nesting of a student's behavior scores at each measurement occasion (1, 2, and 3) within each student (A, B, C, etc.).

Summary

TCIT is a classroom management technique that is supported by previous research, but data collection options are currently limited to self-report scales. Validating a behavioral measure

will provide another choice for researchers, or allow them to bolster their data set with both measurements. Providing a more complex analysis can provide a better picture of improvement challenging children make during the TCIT intervention.

CHAPTER III

METHODS

Introduction

As TCIT research continues, it needs a valid behavioral measure to provide a less bias snapshot of changes over time. Though other measures exist, a frequency based behavioral measure gives a whole other objective look at the effects of the therapy. The first objective of this study was to validate the Behavioral Observation of Preschoolers System (BOPS), created by Campbell (2011). Evaluating the psychometric properties of the BOPS allows it to be a more resourceful and useful tool as an alternative to other traditional Likert-type scales to measure behavior. The second objective of this study was to apply MLM to demonstrate the changes in student behavior over time as well as the contextual effects of students nested in classrooms. If successful, this model can provide information about the effects of TCIT in students with behavior problems, students without behavior problems and in classrooms as a management tool.

Research Design

The data were collected by Dr. Christopher Campbell, not by the author directly. A team of research assistants were tasked with collecting the observational data as well as demographic and other scale data from the classrooms. Observational data are unique in that the information is

collected without explicit involvement from the participant. A trained research assistant watched the child and recorded the activity the child was engaged in. The intention when the data were collected was to develop a multiple baseline design, but given the time intervals throughout the intervention, the data are suited for an MLM analysis.

Participants/ Sampling Information

Target population. The population of interest in this study was Head Start in the United States. A dense variety of literature already exists to compare demographics and results for generalization.

Participants. The data analyzed in this study was previously collected from six different Head Start classrooms in two Midwestern state counties. Overall there were 101 students in six classrooms with the six different teachers.

Teachers. The six lead teachers in those classrooms ranged in age from 25 to 54 years old. Five of the teachers had a bachelor's degree and the sixth had a master's degree. The teachers had been educators in Head Start for six months to 10 years. The teachers all reported being of European American descent and female.

Students. Nested inside the classrooms were 101 students (50 female, 51 male). Of the students, only 85 were included in the analysis. The other 16 were excluded because of missing data. On average each classroom had 17 students.

Sixty three percent of the students were of European American descent. The remaining students were African American (15%), Latino (14%), Asian/Pacific Islander (1%), and

Multiracial (7%). This demographic would likely generalize in most rural Midwestern areas, but based on the Department of Health and Human Services 2009-2018 data, only 44% of Head Start students are identified as European American, 30% are African America and 10% are Multiracial (citation). The age of the children ranged from 2.75 to 6.17 years.

Data Collection

Trained research assistants were stationed in each classroom to collect the data during various parts of the day. The research assistants observed behaviors for 25 seconds, then recorded the specific activities the child was engaging in for five seconds during in 15-minute observations sessions. Data collection took place in 8 weeks while TCIT intervention was taking place. There are six observations for each student during the course of the study.

Instrument

The BOPS was not the only instrument used to collect the data in the original study, however it is the measure of interest for this study. This 35-item frequency-based measure contains a list of pro-social and challenging behaviors. Five of those items are rare behaviors but important to note if they are captured during an observation (i.e. sexual behavior, pica, etc.).

Data Analysis

Exploratory factor analysis (EFA) was used to identify the underlying factors in the BOPS that were naturally related in terms of the item behaviors. Principal Axis Factoring was selected as a specific type of EFA because the assumption of normality was not met in all items. Given the orthogonal structure of the measure a varimax rotation was selected. Some items on the

measure are prosocial behavior and others are challenging behavior, so it is expected that there will be little to no correlation between those items. The items not contributing were removed. It is expected the rare behaviors will not contribute to the model, though they are important to include, potentially as dichotomous variables independent of the observational scale. The KMO value and Bartlett's test for sphericity will help determine if the data are appropriate for the analysis. The number of factors retained will be determined by a combination of parallel analysis, scree plot and knowledge of the scale.

Exploratory multilevel modeling was used to identify significant effects over time (fluctuation) within students as well as within person effects and account for the nested structure of occurrences within students within classrooms. The fluctuation over time allows for the initial conditions and the dramatic improvement to be accounted for. Some children may see more distinct growth, while others have small improvement with already exemplary behavior. The level two within persons effects include gender and age, while the between effects of classroom and teacher experience are included in the third and final level.

Summary

The analysis used in this study will provide the foundation for use of the BOPS in future studies and solidify it as a unit of behavioral measure for TCIT as well as other child behavior intervention methods that would benefit from a behavioral measure. Further, validation of this measure will identify key components contributing to the challenging behavior and effects of intervention. MLM can account for the initial behavior conditions of each student to show individual improvement over time as opposed to a mean of improvement of a group.

CHAPTER IV

FINDINGS

Introduction

Principal Axis Factoring (PAF) was selected as the method of analysis for validating the BOPS. Validation of this measure will allow researchers to have an alternative to self-report measures currently available. A Multilevel Model was constructed to analyze the variability in scores over time accounted for with-in subjects and between subjects. Model building included a level one time variable that represents each student's change over time, a level two variable that represents each student's behavior in reference to the mean student behavior, and a level three variable that represents the classroom level variance. The more common alternative would be a repeated measures ANOVA, but it lacks the ability to distinguish each students' change over time and the naturally nested nature of the data in classrooms.

Demographics

The data used for the exploratory factor analysis (EFA) differed from the data used for multilevel modeling (MLM) because of participant drop-out. The data used for the EFA included 85 participants (43 [50.6%] male, 42 [49.4%] female) attending six different Head Start classrooms with between 13 and 15 students per classroom. The mean age was 53 months. Though the small sample size is small (N=85), simulations have shown N=50 to be a reasonable minimum sample size that can yield reliable EFA results (de Winter, Dodou and Wieringa, 2009).

The data set used for the MLM was further restricted to participants with data for every occasion measured. There were 67 participants measured throughout all occasions from five different Head Start classrooms. The mean age continued to be 53 months, and there were 33 (49.3%) males and 34 (50.7%) females remaining in the data set. Ethnicity is provided in Table 1.

Table 1.
Frequency and Percent of Sample Demographics for Data Used in the EFA and MLM Analyses

		EFA		MLM	
		N	%	*N*	%
Gender	Male	43	50.6	33	49.3
	Female	42	49.4	34	50.7
Race/Ethnicity	White, Non-Hispanic	53	62.4	48	71.6
	White, Hispanic	14	16.5	12	17.9
	Black or African American, Non-Hispanic	10	11.8	1	1.5
	Black, Hispanic	1	1.2	0	0.0
	Asian, Non-Hispanic	1	1.2	1	1.5
	Biracial, Non-Hispanic	5	5.9	4	6.0
	Multiracial, Hispanic	1	1.2	1	1.5

Research Question 1

After removing the three items that were rare behaviors, the PAF had a KMO = .786 indicating a satisfactory structure for the analysis. Bartlett's test for sphericity was significant ($p < .001$), indicating the sample size was sufficient for the analysis. The determinant of the correlation matrix was greater than zero (2.900×10^{-17}), indicating that the matrix is nonsingular. The full rotated factor matrix is located in Table 3.

A parallel analysis revealed five factors for the data structure. The scree plot supported the five-factor model, though there were nine factors with eigenvalues greater than one. The total variability explained by the five-factor model before rotation is 62.18%. The first component

accounts for more than half of the variability in the model. Table 2 contains the five factors total variance explained.

Table 2. Total variance explained with the five-factor model; initial eigenvalues and extracted loadings

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
1	12.877	34.804	34.804	12.629	34.132	34.132
2	4.235	11.446	46.250	4.004	10.821	44.953
3	3.109	8.403	54.654	2.799	7.564	52.517
4	2.235	6.041	60.695	1.912	5.168	57.685
5	1.949	5.268	65.963	1.664	4.499	62.183

The varimax rotation provided a very clean loading structure with few cross loading items. Only three of the items loaded on three different factors. The first and largest contributing factor was associated with aggressive behaviors that students display while in the classroom. The BOPS designated aggressive behavior as being toward peers, adults, or general, all of which ended up in this factor. Disruptive noise was also in this factor, as well as one item that did not fit well; sharing with adults. These aggressive behaviors are likely easy for a researcher to spot and originally made up half of the Challenging Behaviors part of the BOPS. The second factor contained all but two of the self-regulating and imitating items designated by the initial scale. It also contained crying which doesn't fit with all of the other items, but only loaded on one factor and just barely above the .30 suppression parameter.

The third factor contained all of the items designated by the BOPS for Cooperation with Adults except sharing with adults and inviting adults to play. These things included active and passive participation, as well as following instructions and compliance. The fourth factor

consisted of the Peer Interaction items and one other item - independent observation. And the fifth and final factor contained all of the Challenging Behavior items from the BOPS scale that were not listed in the first factor, as well as the independent activities item. These behaviors include ignoring established activities, encouraging challenging behavior and ignoring activities.

The BOPS was designed with five factors, but one of them was the rare behaviors that were disregarded due to their relative infrequency. Clinging was the only behavior not associated with one of the five factors. When comparing the BOPS as it was designed to the five-factor model, there are a lot of similarities with one large distinction. The Challenging Behavior needs broken into two categories. The EFA results would indicate that being aggressive is inherently different than disrupting class in a variety of ways. Table 3 contains the factor loadings with the specific items from the BOPS.

Table 3. Rotated Factor Matrix with factor loadings

	1	2	3	4	5
Q1 - Child Interacts with Teacher(s)/Adult(s) in a Developmentally Appropriate Manner			.627		
Q2 - Follows Instructions form Teachers/Adults Appropriately for His/Her Developmental Level			.804		
Q3 - Continued Compliance			.809		
Q4 - Passively Participates in Teacher/Adult Scheduled Group Activity		-.381	.422		
Q5 - Actively Participates in Teacher/Adult Scheduled Group Activity			.302		

Q6 - Talks to Teacher(s)/Adult(s) in a Developmentally Appropriate Way					
Q7 - Shares with Teacher(s)/Adult(s)	-.393	.306			
Q8 - Invites Teacher/Adult to Play		.487			
Q9 - Actively Playing with Peers				.757	
Q10 - Talks to Peers				.819	
Q11 - Shares with Peers				.716	
Q12 - Invites Peers to Play		.344		.763	
Q13 - Waits Their Turn	-.420	.545	.409		
Q14 - Imitation of Peers					
Q15 - Comforts Peers in a Developmentally Appropriate Way		.576		.378	
Q16 - Solves Problems with Peers			.300	.340	
Q17 - Independent Tasks of Daily Living		.521	.350		
Q18 - Independent Observation				.357	
Q19 - Independent Activities				.374	-.513
Q20 - Smiles or Laughs		.737			
Q21 - Child Seeks Comfort from Others in a Developmentally Appropriate Manner		.605			
Q22 - Apologizes for Accidental or Purposeful Behavior		.697		.347	
Q23 - Displays Self Soothing Behavior		.747			
Q24 - Cries		-.312			
Q25 - Defiance	.349		-.634		.416
Q26 - Noncompliance			-.704		.430
Q27 - Completes Consequences for Behavior in a Developmentally Appropriate Way		.675			-.351
Q 28 - Disrupts Previously Established Activity or Social Interaction	.478		-.419		.480

Q29 - Makes Disruptive Noises/Talks Out	.565		.362
Q30 - Non-Directed Aggressive Behavior	.722		
Q31 - Displays Verbal Aggression Toward Peers	.809		
Q32 - Displays Physical Aggression Toward Peers	.885		
Q33 - Displays Verbal Aggression Toward Teacher/Adult	.869		
Q34 - Displays Physical Aggression Toward Teacher/Adult	.877		
Q35 - Ignores Activities		-.454	.525
Q36 - Clinging			
Q37 - Encouraging/Supporting Peers' Challenging Behavior	.369		.708

The underlying structure was similar to the researcher expectations when the scale was designed. There were five subsections, but one of the five was not included in the analysis because they were rare behaviors. The items are essentially scored by the research assistant and the scores in each subsection are summed, and then the entire scale is summed. Some of that structure was apparent in the EFA. For example, questions 29 through 34 were all on the first factor in the EFA and they were all in the challenging behavior section of the BOPS. The questions that had no loadings of .30 or higher on the first five factors were questions 36, 14 and 6. These questions in order listed are looking for participants to be "clinging," imitating peers, and talking appropriately to adults. The first two could potentially be hard to recognize or infrequent, but the last of those seems like it should both be frequent and easy to recognize.

Potentially the number of students to teachers prevents this behavior from occurring regularly.

Research Question 2

The BOPS has five subscales which are summed to provide five subscale totals per measurement occasion per student. Those totals are then summed for a total BOPS score. These total scores were analyzed from occasion to occasion represent the individual student's behavioral fluctuation over time. In the MLM, the first level models each student's behavior score over time; it shows the within student variability over occasions. The second level models the student's behavior score in reference to all other student behavior scores. The third level of the model accounts for the contextual effects that come with classroom membership of each student.

The MLM was analyzed in the way that the author structured the scale. The summed BOPS behavior score was used to model the behavior improvement over time in the 67 participants. Figure 3 shows the change in each participant's behavior level over time; each line represents one participant's behavior level at each occasion.

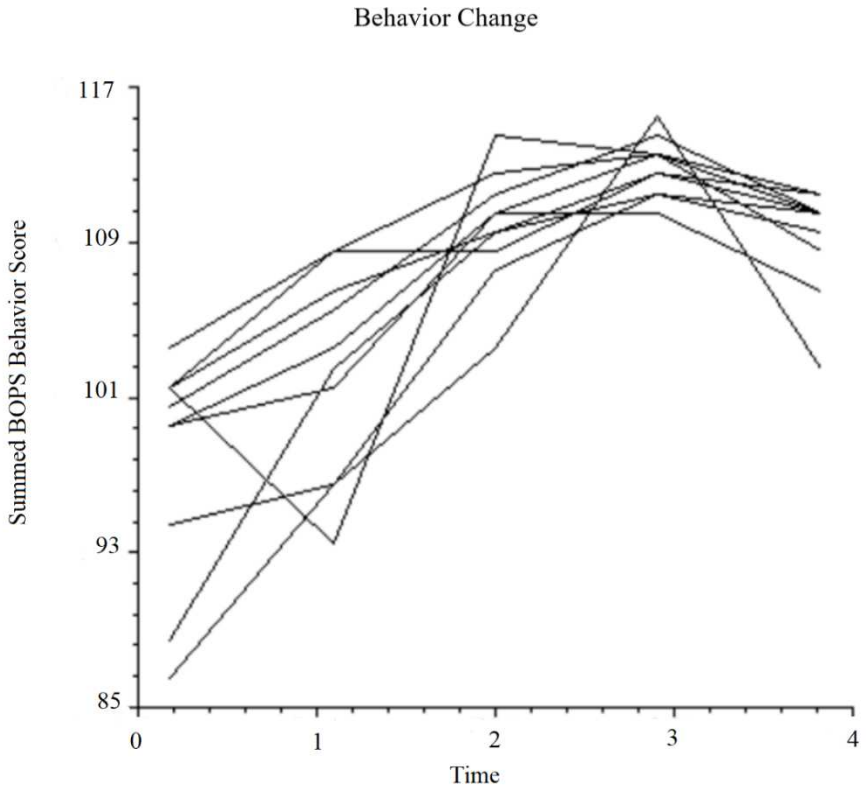

Figure 3. Line graph of each participant's behavior score at the 5 time observations.

First, the null model is presented:

$$(\text{Behavior})_{ti} = \beta_{00} + r_{0i} + e_{ti}$$

In this model, (Behavior) represents the summed BOPS score (the outcome variable), β_{00} represents the grand mean of the summed scores, r_{0i} represents the random residuals at the individual level, and e_{ti} represents within occasions residual variance. The null model had a random intercept that was significant ($p<.001$), and an ICC = 0.812. This indicated that 81.2% of the variability in scores was between participants while the other 18.8% was within participants over time. The total variance components accounted for by the null model was significant ($p<.001$), with 152.8 between persons components and 34.72 within persons components. The

intercept of the null model, or the average summed score of the BOPS at the first measure was 91.73. This represents the grand mean of the behavior observed, and it was significant ($p<.001$).

After checking the null model, the Time variable was added as a level one predictor. In this model $(Behavior)_{ti}$ and β_{00} were the same as they were in the null model. $\beta_{10}*(Time)_{ti}$ represents the change in behavior as time increases, r_{0i} represents random residuals at level one, $r_{1i}*(Time)_{ti}$ represents the change in random effects as time changes, and e_{ti} represents within occasions residual variance. The level 1 error variance was decreased from 34.72 to 21.15 with 5.54 of the variance components now belonging to the random effects of time. The variance components are available for comparison in Table 4. Hypothesis testing confirmed that this was a more desirable model ($\chi^2(2)=56.73$, $p<.001$). The level one intercept was significant ($\beta_{00}=90.72$, $p<.001$). This number represents the mean student intercept. The slope was insignificant ($\beta_{10}=0.45$, $p=.166$). The new model is as follows:

$$(Behavior)t_i = \beta_{00}$$

$$+ \beta_{10}*(Time)t_i + r_{0i} + r_{1i}*(Time)t_i + e_{ti}$$

Table 4. Variance components comparison for the null model and the time dependent model

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
Null Model					
INTRCPT1, r_0	12.35103	152.54804	66	1226.31766	<0.001
level-1, *e*	5.82663	33.94965			
Time Dependent Model					
INTERCEPT1, r_0	12.30733	151.47042	63	351.85860	<0.001
INDEX1 slope, r_1	2.35430	5.54274	63	271.34127	<0.001

level-1, *e*	4.59887	21.14963

After the teacher level variable was added, the residual variability decreased to 17.79 variance components. This suggests that using the predictors at various levels reduced the within-student variability by 45.5%. The level two intercept was significant (β_{00}=89.75, p<.001). This number represents the mean teacher intercept. The slope was insignificant (β_{01}=0.27, p=.721). The slope (β_{10}=2.57, p<.001) and intercept (β_{11}=-0.58, p<.001) at the time level, now nested in the second level variable, continued to be significant. Hypothesis testing reveals that this new model was significantly better than the null model ($\chi^2(2)$=67.68, p<.001), but not significantly different than the previous model. The random coefficients model is as follows:

$$(\text{Behavior})t_i = \beta_{00} + \beta_{01}*(\text{Teacher})_i$$
$$+ \beta_{10}*(\text{Time})t_i + \beta_{11}*(\text{Teacher})_i*(\text{Time})t_i$$
$$+ r_{0i} + r_{1i}*(\text{Time})t_i + et_i$$

For purposes of comparison, the same data could be analyzed using a repeated measures ANOVA. This method was selected because the time variable is discrete, but it is important to note that one of the ANOVA assumptions is equal time between measures and MLM does not share this requirement. The original statistics applied to this data were pre-post test. This analysis compared the mean at time one (92.78) to the mean at time two (94.31). The results of this test with the same MLM sample are not significant.

Summary/Conclusion

The EFA identified the factors to reveal the underlying structure of the data was similar to that which researchers intended with an important split in the Challenging Behaviors factor. Parallel analysis and the scree plot were used to determine that retaining five factors is ideal for

this measure. The MLM was also significant, indicating that a nested structure is appropriate for this data. This is important to note because the changes that occur were vastly due to individual changes over time, or within subjects' variance. The standard analysis currently used in literature to analyze changes compares means, there by losing those changes in each participant from one occasion to the next.

CHAPTER V

CONCLUSION

Introduction

The purpose of this study was to validate the BOPS and see how well the data fit into an MLM. Data were collected from Head Start students and classroom teachers. The EFA revealed an underlying structure that can change the way the behavioral measure is conducted and compiled. The MLM provided a lot of information about the nested nature of the data as well. The goal of using this model instead of the traditional methods was the ability to distinguish the initial conditions of the participants starting the intervention and allow the naturally nested nature of classroom data to be appear.

Five Factors

There were five factors retained the underlying structure was revealed by the EFA. Based on the items in each factor, the prosocial behavior with peers, prosocial behavior with teacher, and self-regulatory subsections would remain intact. The challenging behavior would need to be broke down to two parts; aggression (both verbal and physical and both to teacher or peer) was independent of disruptive or noncompliant behavior.

Was an MLM Necessary?

The significant findings indicate that a multilevel model is necessary to account for differences in students over time as well as the contextual differences in each student by the classroom environment which they are nested. Based on the interclass correlation statistic, over 80% of the variability was between students. The typical way of measuring changes in the students is pre-post test. In this analysis, the mean behavior at time one would be statistically compared to the mean behavior at time two. Any individual change from time one to time two only contributes to the mean, they are not modeled. Further, if the challenging behavior had been a negative value or subtracted from the summative scores, the differences in behavior would be even more dramatic than those displayed by the analysis. Because of the structure of the scale, the students could have started displaying far worse behavior and that would account for their increased score.

Implications

The EFA is the beginning step of validating the BOPS. Through slight modification and continued use, this scale promises to be a valuable tool for researchers looking to use a behavioral measure either alone or in conjunction with a self-report measure. The BOPS is likely more objective than the self-report tools, and if used concurrently could offer a new validation to the tools that have been used to measure challenging behavior for years. Further, the EFA bolsters the available measures by capturing all possible behaviors a child can be engaged in instead of just some of them.

Any time students are in a preexisting group but not assigned based on their initial conditions, the data should be tested to fit an MLM. Effective use of an MLM in this instance

demonstrates a need for a finer analysis in the world of TCIT research. It's inception in a clinical setting where the typical initial conditions were all high in challenging behavior, this likely was not necessary. However, as a standard classroom management tool, the variety of initial conditions is very important. A significant MLM is expected (though not always attained) whenever there are multiple beginning levels nested inside of a classroom.

Contributions to Social Learning Theory

Social Learning Theory is a foundation for TCIT. The idea that limit setting and consistent expectations and consequences shape the positive relationships is evident in the literature, but the structure of the analysis provides further consensus that improving those relationships students have with the classroom teacher can improve behavior. The training that teachers receive is very basically a map of how to increase the desired behavior and decrease undesired behavior through consistent reinforcement. Giving each child their initial conditions in the analysis shows the true change in each student instead of the change in the group mean.

Contributions to the research of behavior

The BOPS was already unique in its frequency based observational design, but what set it apart more than anything was the inclusion of both positive and negative behaviors. The goal to capture any behavior the child could be engaged in showed five different factors in the measure. Whereas other measures only view the negative things a child could be participating in, this allows a distinction between actively participating in class in a meaningful way, not participating at all, or being disruptive and aggressive.

Contributions to the practice of TCIT

The research in this area contains analysis that focus on mean differences. With over 80 percent of the variability being between students, the standard analysis of means is insufficient.

MLM allows the students to have their own initial condition of behavior nested in the classroom. Fine tuning the analysis will allow TCIT to show the dramatic improvement in students with exceptionally poor behavior as opposed to the students with moderately good behavior to begin with.

Limitations and Future Research

One of the things that became problematic throughout analysis was the variety of behavior the BOPS is assessing. The items are essentially scored by the research assistant and the scores in each subsection are summed, and then the entire scale is summed. Most other scales in this area are used in the same way, but most other scales focus on a more specific area. Capturing anything a child can be doing at any time would mean they get points for doing things and then those points are added. If the scale was capturing only challenging behavior, a low score would be good, a high school would be bad, and a summative score would make perfect sense. In this instance, is the score high because of lots of challenging behavior? Or because of lots of prosocial behavior? There really is no way to be sure unless the challenging behavior questions subtract points and the prosocial behaviors add points. That is not the current use.

One of the limitations of this study as well as a suggestion for future research is sample size. Though there are varying beliefs about the ideal sample size for an EFA, 10:1 is a commonly accepted a priori participant: item ratio (Costello & Osborne, 2005). With that being said, and with the knowledge that the initial scale was 40 questions long, a desirable sample size would have been 600 participants. Though this study had far fewer, the KMO and Bartlett's tests indicated the data were substantial for the EFA. Clearly this is well over what was available for this analysis. With six total items removed, a future researcher may want upwards of 500 participants for the EFA and another 500 for the CFA.

Sample size is also an issue for the MLM in this study. There were enough students to effectively model, but the teachers were far fewer. In fact, there were six when it started and one was lost throughout, leaving five available for analysis. MLM will not compute with missing data, so in the future, over estimate the number of teachers needed and anticipate loss due to attrition. Also, as previously stated, it stands to reason that instead of researching the specific teacher or modeling for each teacher in the sample, it makes sense to dummy code them as either experienced and educated or the opposite, using the first of those as the control in the analysis. Previous research says that less experienced teachers benefit the most from the intervention, but if each teacher is modeled, that information is missed. This keeps to the idea that the model can account for student initial conditions nested in specific classroom conditions.

Future studies would benefit from including a self-report measure. The validity and reliability of the self-report measure compared to the behavioral measure would be important to the field of TCIT. Also, there are very old measures available compared to the BOPS, so in the event that the validity was high, it would bolster the BOPS reputation. In the event that it was low, potential bias that are known to effect self-report scales could be the culprit.

This data initially had six teachers, which is not a lot, but with the variety of experience and education, it should have been enough for the level two model to be very substantial, yet it was not much different from the one level model. This could be because the teachers were identified individually so each student was associated with one teacher. Potentially dummy coding teachers by experience and/or education would paint a better picture than accounting for the teachers individually. If the control variable was an experienced and well-educated teacher, the difference between that and the alternative would likely be more apparent. In the future, a

dummy code for the teacher and a new coding system for challenging/prosocial behavior would paint a much better picture.

Conclusion

The EFA shed some light on the underlying structure of the BOPS and allowed for a revision of the existing scale. Though similar in structure to the one developed by researchers, this scale groups the questions a little differently and allows for a new coding system to be used, enhancing the differences in increased prosocial behavior and decreased challenging behavior. The MLM showed significant variability in the random intercepts, or the initial conditions of the student behavior. This was expected, and shows the need for more sensitive analysis in this area of research to show all of the changes over time as well as a consideration in how the teacher data are handled.

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