8-2023

App-Based Academic Interventions for Children With Autism

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APP-BASED ACADEMIC INTERVENTIONS FOR CHILDREN WITH AUTISM

by

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A dissertation submitted in partial
fulfillment of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Psychology

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UTAH STATE UNIVERSITY
Logan, Utah

2023

ABSTRACT

App-Based Academic Interventions for Children with Autism

by

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Utah State University, 2023

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Technology interventions for children with autism have gained popularity within the last 20 years. Interventions that use app technology are commonly used among parents, teachers, and clinicians. However, while most of the research on technology interventions for autistic youth have focused on social skills, fewer studies have examined how apps can be used to help autistic children develop academic skills. The purpose of this research was to examine the current literature on app-based academic interventions for children with autism that used single-case design (SCD) methodology, test an app-based academic intervention with autistic and developmentally delayed preschool children using SCD methodology, and to qualitatively examine how primary caregivers of children with autism view academic apps. In the meta-analysis, we coded 12 SCD articles on app-based academic apps for children with autism and conducted a meta-analysis using between-case standardized mean difference effect size, log response ratio increasing effect size, and a generalized linear mixed model. Each analysis showed significant improvement from the baseline to intervention phase. Participants showed only a 17.9% chance of answering a question correctly in the baseline phase with an immediate change to a 79.8% chance of answering a question correctly at the start of

intervention and a plateau of near 100% around session 20. This indicated that academic app interventions generally appear to work for children with autism. However, when we conducted our own multiple baseline single-case design using a letter and number learning app with preschool children with autism and co-occurring developmental delays, children did not make significant academic performance gains. In our final study, we interviewed three parents of autistic children about the pros, cons, and useful features of academic apps. They also discussed how they and their children felt about academic apps and potential changes and additions that would improve academic apps for their children with autism. Finally, we discuss future directions for academic apps and how they continue to be useful tools for parents, teachers, and clinicians.

(409 Pages)

PUBLIC ABSTRACT

App-Based Academic Interventions for Children with Autism

Cassity R. Haverkamp

Technology, such as tablet/phone apps, robots, video games, and virtual reality, can be used to teach skills to autistic children. Research on technology supports for autistic youth often focus on social skills, a main part of an autism diagnosis. However, autistic children may also have academic challenges, and fewer studies have looked at how technology can teach academic skills to children with autism. We created three studies to look at how academic apps may benefit autistic children. In the first study, we reviewed studies that looked at how academic apps can increase the academic skills of children with autism. We only reviewed studies that included a single subject design (i.e., looks at a single case, such as a person or family, in-depth over time) because they are practical for disabilities that are uncommon and are often used in academic settings. Generally, treatments that used academic apps with autistic children increased their academic skills. In the second study, we tested an academic app for learning numbers and letters. We used a single subject design with five preschool children with either autism or a developmental delay. Most children who used the academic app in our study did not show gains in either numbers or letters. In the final study, we interviewed parents of autistic children and asked them about their experiences with academic apps. Parents talked about the pros, cons, and useful features of academic apps. They added ideas about how academic apps could be improved for their children with autism. Overall, academic apps generally appear to be useful for teaching academic skills to autistic children, and these studies

helped us discover what may be missing in the current research along with future directions for new studies.

ACKNOWLEDGMENTS

Thank you to my mentor, Maryellen McClain, for your encouragement, support, and patience through the process of completing this dissertation. Thank you to my husband, Jake Penrod, for continuing to show love and support throughout the many years it has taken to reach my educational and career goals. Thank you to my family and friends for your encouragement and care from the start of this journey to its finish. A final thank you to the Utah State University Psychology Department and the Emma Eccles Jones College of Education and Human Services for funding this dissertation.

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CHAPTER I

GENERAL INTRODUCTION

Psychologists have a long history of using the best available technology for mental health and therapeutic purposes, from providing easily accessible information on websites to using technology as an intervention tool (Ritterband & Palermo, 2009). One of the first uses of technology in mental health intervention was an online self-help group started in 1982 (Richards, 2012). The field continued to develop techniques online, with the first psychological telehealth services offered in the 1990's (Skinner & Zack, 2004). Within the mental and behavioral health fields, interventions that use technology have greatly increased within the past 20 years with public access to computers, mobile phones, electronic tablets, and other devices that are commonplace in most households in the United States today (Kennedy & Fox, 2013). Several evidence-based treatments have been recreated in highly structured online formats (e.g., Kelders, 2019; Proyer et al., 2014; Proyer et al., 2015; Ritterband et al., 2003).

Technology-based interventions, including online and software-based interventions, are rising in popularity among researchers and practitioners who work with individuals who have a variety of psychological needs (Richards, 2013). Depression (Grist et al., 2019; Pinto et al., 2013), anxiety (Kampmann et al., 2016; Maples-Keller et al., 2017), and eating disorders (Schlegl et al., 2015; Shingleton et al., 2013) have all been treated through technological interventions. Behavioral interventions, such as parent training techniques, have also found a home on technology-based platforms (Baumel et al., 2017; Vismara et al., 2013). Some applications have been tested so extensively that they are considered evidence-based treatments. The rise in popularity of technology-

based and app interventions may be in part because of the ease of using an at-home system for clients as opposed to the resources required to continuously see a licensed provider in person. Likewise, technology-and app-based programs are often cost-effective (Neary & Scheuller, 2018). Mobile applications used to deliver mental health services or that use behavior-based psychological interventions can be approved by the United States Food and Drug Administration (FDA) and can be prescribed by psychiatrists and physicians (Terry & Gunter, 2018).

Children seem particularly attuned to new technologies and appear to be good candidates for using technology-based interventions because using technological devices tends to be highly motivating. Both children and parents frequently report high satisfaction with technology-based interventions (Hollis et al., 2017). Nugent and colleagues (2010) showed that children who were exposed to multiple technologies (e.g., robotics) during a science, technology, engineering, and math (STEM) summer camp had better attitudes towards STEM and showed greater learning than a group without added technology elements. Technology-based interventions for children may target broad well-being (Baños et al., 2017) or focus on specific mental health, developmental, or physical disabilities (Hollis et al., 2017). Some technology-based interventions also aid in communication for children who are deaf or hard of hearing (Meinzen-Derr et al., 2017) or autistic children who have language and communication difficulties (Mirenda, 2001).

A large portion of research in psychological and behavioral technology interventions has focused on autistic individuals. Interventions for children with autism are varied and multifaceted. As children with autism seem particularly attuned to technology interventions, these interventions have become popular in clinics, schools,

and home settings. One theory as to why autistic children often enjoy technology-based interventions is because of their rule-governed and predictable nature or the reduced social interaction, which may be preferred by some autistic children (Baron-Cohen, 2006).To teach important skills (e.g., social, adaptive), interventions often use multiple aspects of technology, such as phone/tablet applications, artificial intelligence (AI), robotics, facial recognition and movement software, and smartwatches (Goldsmith & LeBlanc, 2004). Using technology for intervention has several advantages, including helping reduce the workload for behavior analysts, special education teachers, and clinicians (Esteban et al., 2017). Interventions that use technology can also be practical for parents in the home setting as a standalone tool or as a supplemental platform in addition to ABA and educational services (Meadan et al., 2013). Many interventions that utilize technology are reasonably priced, particularly computer software and phone/tablet applications (Goldsmith & LeBlanc, 2004). Other technology, such as robotic technology, can be expensive but may be available to schools, clinics, or parents through grants or research trials (Goldsmith & LeBlanc, 2004; Sumner, 2016).

Both schools and families should take full advantage of the technological interventions available for children with autism. Tablet and mobile applications are often the most accessible and cost-effective technology options for schools and families, but it may be difficult to find an application with a strong evidence base. Many websites offer a laundry list of possible applications that may be effective for children with autism without providing adequate evidence that these applications are effective for their target population. Other websites colorfully promote a single application, making claims that it is effective for children with autism without presenting research to that effect. This also

seems true for academic app-based interventions where the research base is still emerging, but nonetheless still small.

As children with autism may have difficulties with academic skills (Wei et al., 2012; Westerveld et al., 2018), this is one domain where children with autism could benefit from technological interventions. For schools and families to easily access evidence-based academic applications for children with autism, it is important to conduct a review of the current literature to determine what domains applications cover (e.g., reading, math, science), how long interventionists typically use them to teach skills, and whether those skills are maintained over time. It is not only important for schools and families to understand descriptive information about academic apps, but it is also vital that users know if they work for children with autism. To this end, a meta-analysis of current academic app-based interventions implemented with children with autism is warranted. As most of the studies implementing academic apps with this population are single-case design (SCD) studies, it would be prudent to use SCD studies to meta-analyze the data.

As there is a dearth of research in app-based academic interventions for children with autism, and app developers frequently promote apps without adequate testing with individuals with disabilities, researchers should also continue to directly test these applications for efficacy with children with autism. Young children with autism particularly benefit from early academic intervention to help them as school becomes more challenging in later grades (Wei et al., 2012; Westerveld et al., 2018). Early reading skills (e.g., letter-sound knowledge, alphabet knowledge) and math knowledge (e.g., counting, number knowledge) predict better reading and math outcomes for children with

autism (Titeca et al., 2014; Wei et al., 2012; Westerveld et al., 2018). Because of the lack of research on academic app-based interventions, measuring the effectiveness of a letter and number learning app intervention for preschool-age children with autism in a practical setting utilizing SCD is warranted.

Beyond implementation of the apps themselves, determining their social validity and how parents view academic apps is also an underexplored area of research. It is important to have parent and teacher buy-in when implementing an app-based academic intervention in the home or school setting. When an intervention is implemented with children with autism in the school setting, interventionists often try to generalize the target behavior in the home setting as well (Arnold-Saritepe et al., 2009). However, if parents do not believe the intervention is effective or if it is too difficult to manage, they may choose not to implement it in the home setting (Gulsrud et al., 2016). It is important to make sure that app-based academic interventions are acceptable, manageable, and affordable for parents and caregivers of children with autism. Accordingly, a study qualitatively examining parents' and caregivers' beliefs, practices, and misgivings about app-based academic interventions is justified.

The current dissertation includes three independent studies that address gaps in the literature surrounding the use of technology for academic intervention purposes with children with autism. Study 1 explores the literature on app-based academic interventions implemented with children with autism through a meta-analysis of all relevant app-based academic interventions found in multiple databases to determine the effectiveness of these interventions with children with autism. Study 2 directly tests an app-based academic intervention with preschool children in the Autism and Developmental Delay

special education categories. The intervention uses a multiple baseline SCD to implement the LetterSchool © app to evaluate the effectiveness of teaching uppercase and lowercase letters and numbers. Study 3 examines parent perspectives on the use of app-based academic interventions with their autistic children in the home setting using a phenomenological approach to qualitative research and will include a brief, structured interview with primary caregivers. Taken together, these studies will strongly add to the literature on app-based academic interventions for children with autism.

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CHAPTER II

A META-ANALYSIS OF SINGLE-CASE DESIGN APP-BASED ACADEMIC INTERVENTIOINS FOR CHILDREN WITH AUTISM

Introduction

Children with autism frequently have difficulties with social, language, motor, and adaptive skills (American Psychiatric Association, 2013). Interventions for children with autism frequently target these areas to improve important skills (Eldevik et al., 2009; Reichow & Volkmar, 2010). Children with autism also face academic challenges, although this is frequently overlooked by practitioners and researchers (Keen et al., 2016; Wei et al., 2015; Wong et al., 2015). Some research has focused on interventions that best serve children with autism who struggle with core academic subjects, including reading and math (Alresheed et al., 2018; Chiang & Lin, 2007), although the evidence base in this domain is still developing.

Within the reading domain, children with autism frequently have challenges with reading comprehension (McIntyre et al., 2017; Whitby & Mancil, 2009). Difficulties with inferential thinking, understanding others' experiences, and attention are often cited as possible contributors (Norbury & Nation, 2011). Nation and colleagues (2006) also noted that children with autism often focus on small details within the text rather than thinking about the larger context of the material, leading to difficulties with reading comprehension. When children with autism receive early intervention in literacy skills, alphabet learning, and phonological awareness, they are more likely to have better outcomes in reading (Westerveld et al., 2017).

Children with autism experience similar challenges with math learning. Frequently, children with autism have challenges completing multi-step problems due to

attentional demands (May et al., 2015; Whitby & Mancil, 2009). Likewise, math story problems and applied problems may be difficult due to poor theory of mind skills (i.e., understanding what others are thinking or feeling), which may be compounded by reading comprehension and attention challenges (Whitby & Mancil, 2009). An estimated quarter of children with autism could be clinically diagnosed with a learning disorder in math (Mayes & Calhoun, 2006; Oswald et al., 2016). Children with autism may have better outcomes, particularly in math and literacy skills, later in their school years if they receive intervention in early academic math skills during preschool and early elementary school (Titeca et al., 2014).

Technology-Based Academic Interventions for Autism

Researchers have called for practical options for enhancing academic learning for children with disabilities (Meyer, 2017). Technological interventions are a viable option for teaching academic skills to children with autism. Many children with autism often enjoy the predictable nature of technology (Baron-Cohen, 2006) and may have a natural preference for non-social stimuli (Gale et al., 2019), making technology-based interventions rewarding and ideal for this population. Furthermore, research has shown there is often little difference between administering an intervention via tablet app or through paper and pencil or other modes for children with autism and other developmental disabilities (Arthanat et al., 2013; Marble-Flint et al., 2019). Tablets and technology may be more engaging and stimulating for children with autism and, therefore, may even be preferable (Marble-Flint et al., 2019). Likewise, one study found that special education teachers and teaching assistants believed that tablet-based interventions were best suited for children with autism (Johnson, 2013).

For many years, speech-language pathologists and applied behavior analysts have been using technology-based tools to assist children with autism with communication, including expressive and receptive language (Light et al., 1998; Still et al., 2014), yet research examining how to use technology for interventions with children with autism has often lagged technological developments. In a recent study reviewing technology-based interventions for individuals with autism, researchers only found 67 total empirical articles addressing this topic over 20 years, with most studies conducted after 2010 (Elicin & Kaya, 2017). Likewise, little research in technology-based intervention for autism has focused on improving academic outcomes for children with autism even though these children often have challenges in multiple academic areas (Stephenson & Limbrick, 2013).

While there are many types of technology-based interventions used with children with autism (e.g., video modeling), app technology is often easy to access and is affordable for schools and families, making app-based interventions ideal to deliver academic interventions (Elicin & Kaya, 2017). However, few app-based academic interventions have been tested thoroughly enough to be considered evidence-based, and few studies published in educational and school psychology journals focus specifically on app-based technology interventions (Robinson & Bond, 2017). In one study, special education teachers indicated that tablets were useful tools for children with autism in the school setting, particularly in improving communication, social skills, and overall learning (Yavich & Davidovich, 2019). However, teachers also noted that children with autism may throw a tantrum when their time on a tablet is over (Yavich & Davidovich, 2019), although this can be true for all children when ending a desired activity.

Another study found that switching from an assistive and augmentative communication device to a tablet device allowed for more options for academic content to be delivered to children with autism, including reading comprehension, phonics, reading fluency, writing, and expressive and receptive communication (Stone-MacDonald, 2015). Review papers have also shown that apps used for academic purposes frequently evidence benefits for children with autism. Young children seeking early intervention may especially benefit from early literacy and mathematics learning apps, although this realm of research is still developing its evidence base (Griffith et al., 2020). Elementary-age students are also likely to have success using literacy, reading, writing, math, and science learning apps (Elicin & Kaya, 2017).

Several reviews and meta-analyses have been conducted examining tablet use, apps, and academic interventions with children with autism, although none have focused on all these elements together. Furthermore, not all have examined only single-case design (SCD) studies, which are commonly used to examine interventions among low-incidence populations such as children with autism. SCD studies also align with interventions typically applied in a school setting for children with disabilities (Kratochwill et al., 2013; Shadish, 2014), as few studies have examined tablet interventions in group settings with autism (Aspiranti et al., 2020). Hong et al. (2017) meta-analyzed SCD studies on tablet-mediated interventions for children with autism, although they did not specifically focus on academic app-based interventions. They found that interventions that use tablet technology had a moderate to large effect size for children with autism. Most of these interventions focused on building social skills using video modeling or teaching communication skills through augmentative and alternative

communication tools. However, they excluded SCD studies that did not meet quality standards rather than including all studies and using study quality as a moderator variable. Ledbetter-Cho and colleagues (2018) conducted a meta-analysis examining tablet-mediated academic interventions for individuals with autism. However, they did not specifically focus on app-based interventions and found that many tablets were used as recording devices to teach skills rather than relying on available apps. They also found large effect sizes for tablet intervention effectiveness, although they did not implement multilevel modeling techniques to further explore the data. Shadish (2014) discussed the benefits of including multilevel modeling when conducting SCD meta-analyses. Specifically, many effect size metrics either do not account for trend or assume no trend in SCD data, which is problematic (Shadish, 2014; Shadish, Zuur, et al., 2014). Multilevel modeling allows researchers to examine trend and how nonlinear trends might affect results (Shadish, 2014). Ledbetter-Cho et al. (2018) also did not include any gray literature (e.g., dissertations, conference proceedings) to combat publication bias effects, which is recommended (McClain et al., 2021).

Kokol and colleagues (2019) reviewed studies on game-based interventions for children with developmental disabilities, including autism. The researchers found that while several of the technologies showed promise, most interventions were not well-researched, including those for educational purposes. This study also only examined six applications in total. Petersen-Brown et al. (2019) meta-analyzed touch devices (e.g., tablets, mobile phones) for academic instruction with both general and special education populations. Results indicated moderate effect sizes, particularly for randomized controlled trials, with reading and math skills most investigated. However, this study did

not specifically focus on individuals with disabilities and included only a few moderator variables.

Larwin and Aspiranti (2019) conducted a meta-analysis of tablet-based academic interventions for autistic students. Results showed that most children in the studies evidenced increases in skills and most interventions showed strong, positive effects. This study included hierarchical linear modeling techniques but included studies besides those focused on academic apps. Likewise, only literacy and math interventions were analyzed. Finally, Aspiranti and colleagues (2020) examined the academic outcomes of students with autism when using tablets. This study only included group design studies rather than SCD studies. This study found a large effect size for using tablet technology as a supplemental intervention to academic instruction. However, the study was limited in that it only contained four studies and did not incorporate moderator variables such as cognitive ability or co-occurring disabilities (e.g., speech-language impairment, attention-deficit/hyperactivity disorder).

The Current Study

Children with autism often have academic difficulties, particularly in areas requiring reading comprehension and multi-step problem-solving (Keen et al., 2016; Wei et al., 2015; Wong et al., 2015). However, as more literature emerges on app-based tablet interventions, these interventions seem well suited to engaging children with autism and teaching them skills in academics. As the state of tablet technology has now readily been available to the public for at least 10 years, the research base regarding academic interventions for children with autism may now be large enough to conduct a meta-analysis specifically targeting the effects of app technology. The current study is a meta-

analysis of studies examining the outcomes of app-based interventions on academic skills in children with autism. Most studies examining tablet interventions with children with autism use SCD (Elicin & Kaya, 2017), as SCD is a popular form of intervention for children with low-incidence disabilities in the school setting (Kratochwill et al., 2013; Shadish, 2014). Therefore, it is a practical consideration that this study will only examine studies that use SCD. Furthermore, as previous reviews and meta-analyses show, this area of research is still developing, and it is important to collect all articles and research on app-based academic interventions for children with autism, including dissertations, theses, and conference proceedings. This approach will also combat publication bias through the inclusion of gray literature. Finally, this study includes children ages 3 to 12 years, focusing on children in preschool and primary school who are most likely to benefit from app-based early academic intervention. This study includes two primary research questions:

1. What is the effectiveness of app-based academic interventions for children with autism?
2. What is the effectiveness of app-based academic interventions for children with autism across specific moderator variables (e.g., race/ethnicity, cognitive ability, co-occurring disability)?

Method

Article Search

The article search was conducted in four databases that commonly index journals with education topics and autism: ERIC, PsycINFO, SCOPUS, and PubMED. Search terms included: (“iPad” OR “tablet” OR “application”) AND (“students” OR “child*”

OR “adolescen*” OR “youth”) AND (“academic*” OR “reading” OR “writing" OR "literacy” OR “numeracy” OR “science” OR “math*” OR "language") AND (“autism*” OR “autistic*” OR “Asperger*” OR “ASD” OR “pervasive developmental disorder” OR “PDD*”). Inclusion criteria for articles included: (a) the use of a SCD methodology, (b) inclusion of at least one participant with autism, (c) participants between the ages of 3 and 12 years old, (d) examination of an app-based intervention, (e) an app that teaches academic skills (e.g., reading, writing, mathematics), and (f) inclusion of a graph with data points for each participant for each academic intervention. The search resulted in 861 total peer-reviewed articles, theses/dissertations, and conference proceedings. The research team used the Preferred Items for Systematic Reviews and Meta-Analyses (PRISMA; Liberati et al., 2009) to organize articles and show the review process. After briefly scanning titles and abstracts that appeared promising (e.g., included autistic children, used an educational app), 122 articles appeared appropriate for full article review. During full article review, each inclusion criteria was carefully checked. A total of 11 articles met the full study criteria. An ancestral search resulted in 16 further articles for full review and led to the addition of 1 article to the final count. Overall, 12 articles met the full criteria for inclusion. Figure 1 presents a copy of the PRISMA diagram for this study.

Coding

Two researchers independently reviewed the final articles to be included in the meta-analysis. Each reviewer coded relevant information from each article, including moderator variables to be used in the analysis. All outcome data were extracted directly from SCD graphs within each article by hand using a flat measurement tool. Each coder

extracted data, and it was reviewed by the coders and outside researcher for accuracy. The researchers used Research Electronic Data Capture (REDCap; Harris, 2009) as the tool to code the data (Appendix A). REDCap is an online data collection tool that can be used to build surveys and data entry questions. REDCap includes several tools that were well suited to this study, including a comparison tool for multiple coders and repeating forms for more than one participant within an SCD study. Initial interrater reliability was calculated with 87% agreement. The two coders and an outside researcher (who served as a tiebreaker) discussed discrepancies until the coders reached 100% agreement. Table 1 shows the final studies and characteristics.

Study Level Variables

Study-level variables coded included: (a) author, (b) year, (c) type of SCD study (e.g., multiple baseline, ABAB reversal, alternating treatments), and (d) study design quality (i.e., meets What Works Clearinghouse (WWC) design standards, meets WWC design standards with reservations, or does not meet WWC design standards). WWC design standards can be found in Kratochwill et al. (2010) which includes SCD technical documentation. It was created by a panel of experts in SCD to provide guidelines and standards for conducting SCD studies. Criteria for designs to meet evidence-based standards according to WWC include (1) Systematic manipulation of the independent variable, (2) Inter-assessor agreement must be conducted on 20% of data points in each phase for each participant and must meet minimum thresholds for inter-assessor agreement, (3) Three attempts to demonstrate an intervention effect either by either by multiple time-points or phase repetitions, and (4) Each phase needs a minimum of three data points.

Participant Level Variables

Participant level variables included both demographic information related to each participant and information about the intervention each participant received. Coded demographic variables included: (a) subject identifier (i.e., pseudonym in study), (b) age, (c) grade, (c) race/ethnicity, (d) diagnosis (e.g., ASD, ASD and SLI, ASD and ADHD), (e) cognitive ability (i.e., IQ score), (f) gender, and (g) school setting (i.e., urban, suburban, rural). Coded intervention variables included (a) domain (i.e., academic subject explored in the intervention), (b) intervention length, (c) outcome type (e.g., number correct and percent correct), (d) maximum possible score, (e) number of time points overall, (f) intervention phase, (g) time points in each phase, and (h) number of domains.

Statistical Analysis

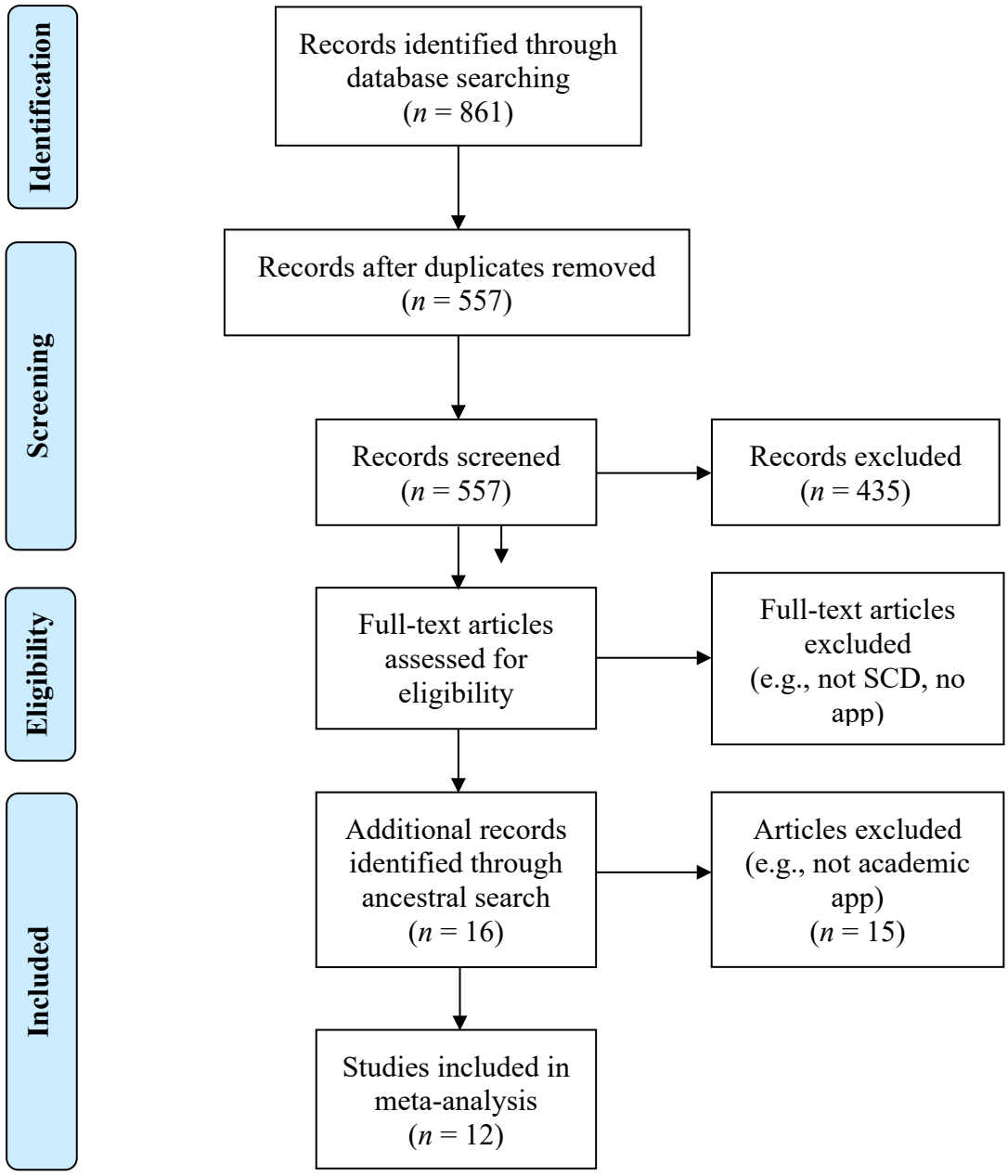
Analyses were conducted using the most recent version of R (version 4.2.2; R Core Team, 2022). The REDCap collected database was imported directly into the *R 4.2.1* (R Core Team, 2022) through the API interface where all quantitative analysis was conducted. Full details are available in the supplementary material found in Appendix B. As recommended by Shadish and colleagues (2014), this SCD meta-analysis implemented between-case design comparable standardized mean difference (BC-SMD) which controls for differences in SCD studies (e.g., experimental design). BC-SMD was used as the main measure of effect size to determine intervention effectiveness. Pustejovsky and colleagues (2014) created a framework for using BC-SMD in SCD meta-analyses specifically in R, which informed the current meta-analysis. Due to the challenges of determining baseline and intervention phases for alternating treatments studies, only one alternating treatments study with a clear baseline phase was chosen for

this analysis. Likewise, one study that had an unusual phase progression was not included due to challenges determining which intervention phase was more appropriate for analysis. In addition to the BC-SMD analysis, the log response ratio for increase (LRR-i) was used to determine within-case effect size, and then researchers determined the robust variance estimation via a meta-regression analysis. Due to the range of between-study and within-study variance, a moderator analysis was conducted to explore which specific participant and study variables accounted for this difference. Moderator variables included race/ethnicity, age (categorical from 1-6 years and 7-12 years), diagnosis, and study design quality. Age was split to determine if academic interventions were more successful with preschool and kindergarten children as compared to elementary school children.

Multilevel modeling using a generalized linear mixed effects model (GLMM), which is like logistic regression, was used to further analyze the SCD data and provide additional information about the moderator variables (Onghena et al., 2018). GLMM was chosen because scores exhibited a ceiling effect (100% correct). Specifically, answering items either correctly or incorrectly created a non-normal distribution capped at 100% correct. GLMM uses a correct/incorrect model like logistic regression. Level 1 included the correlation between repeated measurements taken on participants. Level 1 data were nested within level 2, which included participant information and demographics, and level 2 data was further nested within level 3, which included broader information about the study. By using the inverse logit, estimated coefficients (odds ratio, *OR*) were converted into the probability of receiving a correct response on academic app-based programs. Sessions were centered so that the intervention started at time 0.

Figure 1

PRISMA Diagram



Results

Overall, effect size analyses showed that academic apps improved autistic children's academic skills in different domains. BC-SMD analyses ($k = 7$) resulted in students showing a significant gain in academic skills after the start of the intervention (M = 3.85, 95% CI [2.16, 5.54], $p < .010$). Figure 2 displays a forest plot of the BC-SMD effect size values.

LRR-i ($k = 8$) results confirm the BC-SMD analyses. Results indicated academic apps increased the number of problems answered correctly once the intervention was implemented, with overall group contingencies at 1.69, 95% CI [1.06, 2.32], $p <.001$. This suggests that participants answered academic questions correctly a little over one and a half standard deviations more during the intervention phase than during the baseline phase. The between-study variance was .68, and the within-study variance was .24, indicating that there was more variability between participants than within each participant, which is expected in SCD research (Shadish, Hedges, et al., 2014). See Figure 3 for a forest plot of the LRR-i analysis.

Each of these moderator variables (race/ethnicity, $\chi^2(6) = 57.75$, $p < .001$; age, $\chi^2(2) = 95.69$, $p < .001$; disability, $\chi^2(5) = 27.80$, $p < .001$; method quality, $\chi^2(3) = 31.05$, $p < .001$) was significant and affected children's performance when using academic apps. Due to the low power in many of the moderator variables, results are presented, but they should be interpreted with caution. For the race/ethnicity variable, Indigenous ($p <.001$), Latinx ($p = .013$), Multiracial ($p = .012$), Native Hawaiian/Pacific Islander ($p = .047$), and White ($p <.001$) children with autism all showed statistically significant academic improvement during an app-based academic intervention, while a Black ($p = .301$)

student did not show significant improvement using an app intervention. Results are shown in Table 2.

While both preschool/kindergarten-aged (p <.001) children and children in elementary school (p <.001) did not differ significantly in their academic improvement overall, younger children tended to show more improvement, though both age groups showed significant improvement in skills following an academic app intervention. Regarding disability (either autism alone or autism with a co-occurring disability) children with autism/Asperger's (p <.001), autism and ADHD (p = .045), autism and intellectual disability (p = .026), and autism and another disability (p = .001) all showed significant improvement when using app-based academic interventions. However, a child with autism and a speech-language impairment did not show significant improvement during the intervention phase (p = .067). When examining the study-level variable of WWC study quality, studies that met the WWC criteria (p = .005) and studies that did not meet the criteria (p <.001) both showed that children improved their academic skills with academic apps. Studies that met the WWC criteria with reservations (p = .058) did not show statistically significant gains.

Results (k = 8) from the GLMM analysis verified the results of the BC-SMD analysis. A two-way interaction between the session number and the intervention was significant. The predictor variables of age and study design quality were examined as main effects in the model, but they were not significantly better than the first model looking at session number and intervention only. Likewise, when examining a three-way interaction with these variables, the models did not converge. Several predictors (e.g.,

autism and another diagnosis) were too few in the data set to analyze in the GLMM analysis. Table 3 shows the results of the GLMM analysis.

During the baseline phase, the chance of a correct response was 17.1%, 95% CI [7.0, 35.3], averaged across all studies, domains, children, and items, OR = 0.21, p = .002. After the first session of intervention, the chance of answering a question correctly increased immediately to 78.9%, 95% CI [57.6, 91.1], OR = 17.76, $p < .001$. There was not significant longitudinal change during the baseline phase, odds = 1.01, $p = .703$, indicating a stable baseline. After the start of the intervention, children's performances continued to drastically improve with further intervention, such that the odds of answering each item correctly increased by 15% per session, OR = 1.15, $p < .001$. After 15 sessions, the chance of answering am item correctly reached 97.2%, 95% CI [92.6, 99.0]. By about session 20, scores plateaued around 100%. Figure 4 graphically depicts the GLMM analysis via predicted probabilities over sessions.

Table 1

Studies Included in the Meta-Analysis

Authors (Publication Year)	Academic Domains	Dependent Variable	App Name	WWC	Number of Sessions	Study Design (*N*)	Age in Years (Grade)
Browder et al. (2017)	Story Element Definitions, Story Element Labels, Reading Comprehension	Number of correct pairings of story element word to definitions, labeling electronic touch-based story map, number of comprehension questions answered correctly	SMART Notebook with researcher developed stories and story maps	Does Not Meet	12-26	MB (3)	8-10 (2-4)
Coleman-Martin et al. (2005)	Vocabulary	Word identification using a nonverbal reading approach	PowerPoint with individual phonemes verbally presented, then the entire target word	Does Not Meet	16	Other[1] (1)	12 (NA)

Table 1
(continued)

Authors (Publication Year)	Academic Domains	Dependent Variable	App Name	WWC	Number of Sessions	Study Design (*N*)	Age in Years (Grade)
Coogle et al. (2018)	Vocabulary	Vocabulary-naming probe tracking ability to name target vocabulary	PowerPoint with dialogic reading verbally presented with pictures	Meets Fully	10	AT (4)	3-4 (PreK)
El Zein et al. (2016)	Reading Comprehension	Curriculum-based measure probe of reading comprehension using 4 main idea multiple-choice questions	Space Voyage app where player reads a paragraph and provides the main idea of the paragraph	Meets Fully	14-15	AT (3)	9-10 (4-6)
Jowett et al. (2012)	Numeracy	Ability to identify, write, and comprehend the quantity of numbers 1-7	iMovie with child who counts Angry Birds and demonstrates writing numbers	Does Not Meet	23-63	MB (1)[2]	5 (K)

Table 1
(continued)

Authors (Publication Year)	Academic Domains	Dependent Variable	App Name	WWC	Number of Sessions	Study Design (*N*)	Age in Years (Grade)
Keating (2018)[a]	Phonics	Literacy acquisition, academic engagement, challenging behavior	Hooked on Phonics app where app said word aloud, child chose word, and once all target words were learned, child read a book with target words	Meets Fully	30-75	Other[3] (3)	5-6 (NA)
O'Brien et al. (2018)	Reading Fluency	Rate of correct letter-sound correspondences	PowerPoint with a letter presented on each slide within 3 stimulus sets	Does Not Meet	7-16	MB (4)	3-4 (PreK)

Table 1
(continued)

Authors (Publication Year)	Academic Domains	Dependent Variable	App Name	WWC	Number of Sessions	Study Design (*N*)	Age in Years (Grade)
Root (2016)[a]	Math Vocabulary, Math Problem Solving	Math vocabulary, word problem solving, total problems solved, generalization of word problem solving, self-initiated prompting, global mathematics ability, perception of word problems solving	SMART Notebook with self-directed math problems displayed and verbal prompts	Meets with Reservations	11-14	MB (1)	12 (6)
Root et al. (2019)	Math Problem Solving	Mathematical problem solving measured by number of task analysis steps completed independently	GoWorksheet app where students asked to work through each step of math problem with verbal support as needed from interventionist	Meets Fully	10-13	MB (3)	10-11 (4-5)

Table 1
(continued)

Authors (Publication Year)	Academic Domains	Dependent Variable	App Name	WWC	Number of Sessions	Study Design (*N*)	Age in Years (Grade)
Seok et al. (2015)	Spelling	Frequency of the writing practices	Play with the Korean Language app where the app presented words and students practiced writing the words	Meets Fully	40	AT (1)	8 (1)
Smith et al. (2013)	Science	Number of independent correct responses made on assessment items	Keynote app where students used the slideshow to present 3 science terms and applications per unit with comprehension questions	Meets with Reservations	9-11	MB (3)	11-12 (6-7)

Table 1
(continued)

Authors (Publication Year)	Academic Domains	Dependent Variable	App Name	WWC	Number of Sessions	Study Design (*N*)	Age in Years (Grade)
Weng (2014)[a]	Number Identification, Math Problem Solving, Math Calculation	Percentage of independently saying/pointing at smaller numbers on number lines, percentage of independently pointing at the lower-priced items, percentage of task analysis steps completed independently, time to complete the task	iOS number line app developed by the researcher to select the lower price of 2 grocery items on a number line	Meets Fully	20-25	AT (3)	12 (MS/JrH)

Note. WWC = What Works Clearinghouse; AT = Alternating Treatments; MB = Multiple Baseline; K = Kindergarten, PreK = Preschool; MS/JrH = Middle School/Jr. High School.

[a]Dissertation.

[1]ABAB+CAC

[2]Multiple Baseline across Conditions (one participant across 7 numeracy conditions)

[3]ABCB

Table 2

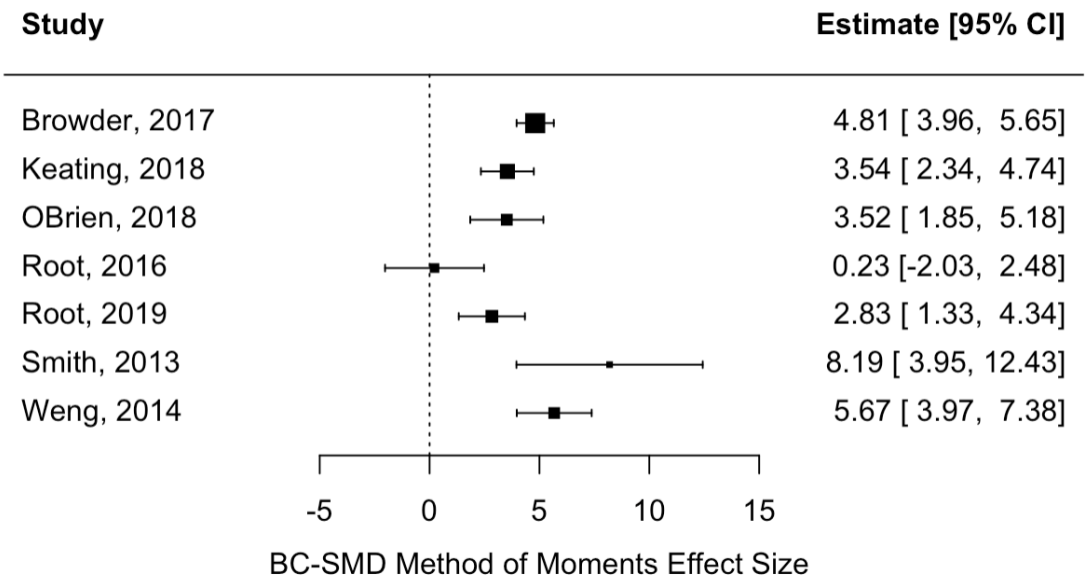
Moderator Variable Effects on Academic App Intervention Effects for LRR-i

Moderator Variable	Number of Studies	Number of Participants and Domains	LRR-i Estimate [95% CI]	*p*-value
Race, $\chi^2(6)=57.75, p<.001$				
Indigenous	1	1	3.27 [1.88, 4.67]	<.001
Black	1	1	0.51 [-0.46, 1.49]	.301
Latinx	1	3	0.90 [0.19, 1.60]	.013
Multiracial	1	2	1.31 [0.29, 2.33]	.012
Native Hawaiian/Pacific Islander	1	1	1.30 [0.02, 2.58]	.047
White	5	15	1.36 [0.91, 1.81]	<.001
Age, $\chi^2 (2)=95.69, p<.001$				
1-6 years	5	8	2.71 [2.04, 3.38]	<.001
7-12 years	5	20	1.21 [0.80, 1.62]	<.001
Disability, $\chi^2 (5)=27.80, p<.001$				
Autism	7	21	1.74 [1.03, 2.45]	<.001
Autism + SLI	1	1	1.31 [-0.09, 2.72]	.067
Autism + ADHD	1	1	1.53 [0.04, 3.02]	.045
Autism + Intellectual Disability	2	3	1.36 [0.17, 2.56]	.026
Autism + Other	1	2	2.37 [1.02, 3.72]	.001
WWC Method Quality, $\chi^2 (3)=31.05, p<.001$				
Meets Criteria	3	9	1.43 [0.43, 2.44]	.005
Meets with Reservations	2	5	1.18 [-0.04, 2.40]	.058
Does Not Meet	3	14	2.31 [1.29, 3.33]	<.001

Note. SLI = Speech-Language Impairment; ADHD = Attention-Deficit/Hyperactivity Disorder; WWW = What Works Clearinghouse. Confidence intervals and p-values are based on sandwich estimators for the standard errors and small sample corrections based on Satterthwaite approximation for degrees of freedom, which is more conservative than the chi-square test of moderators.

Figure 2

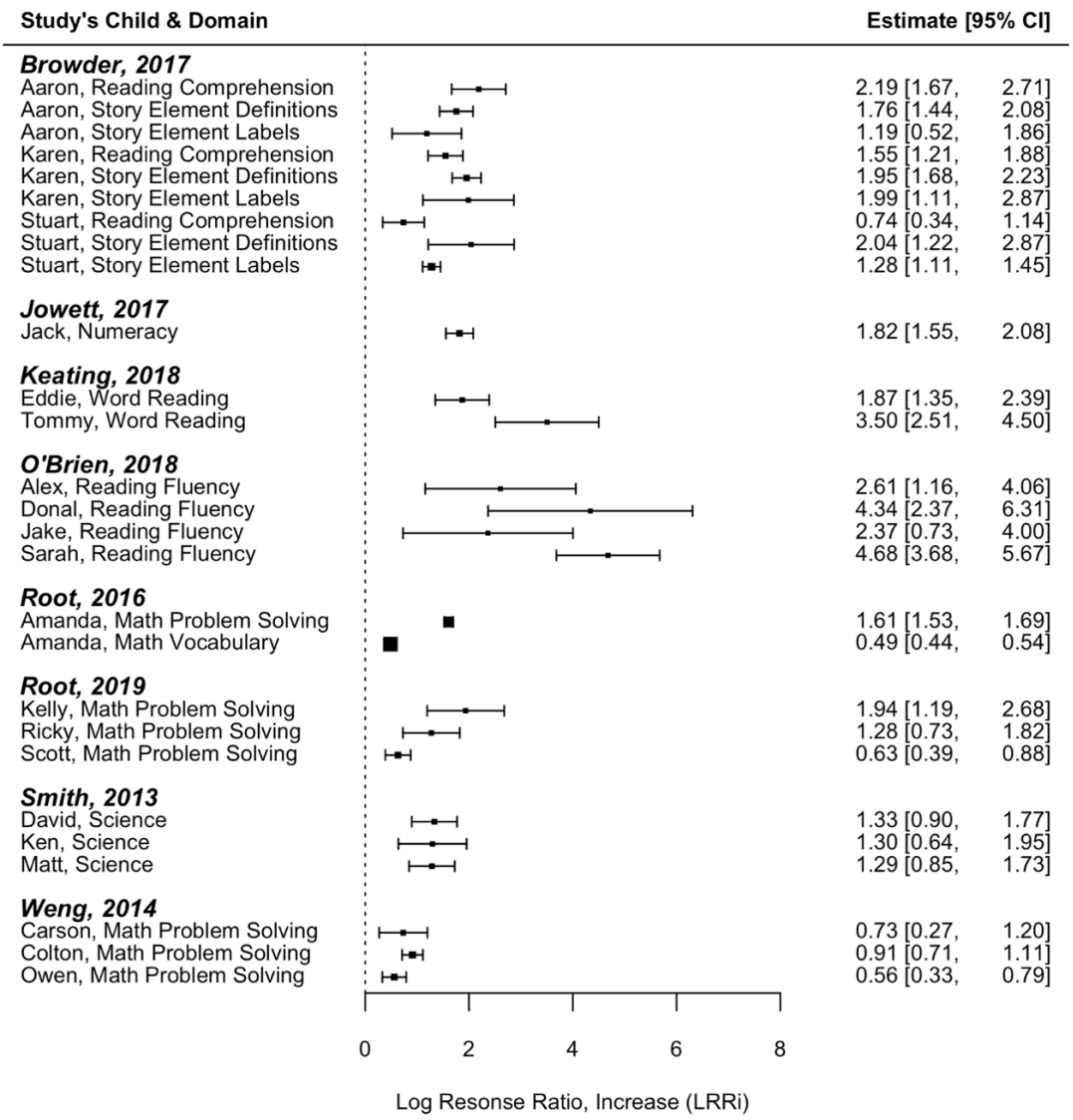
Forest Plot of BC-SMD Effect Size Estimated for Each Study



Note. BC-SMD = Between-case design standardized mean difference assuming no time trend. Point size indicate number of observations within a study. BC-SMD values at or below 0 show no improvement in academic skills.

Figure 3

Forest Plot of Log Response Ratio – Increase (LRR-i) Effect Size Estimates Aggregated for Participant and Domain



*Note. A*ssumes no time trends. Point size indicates number of observations for each participant and domain within each Study. LRRi values at or Below 0 show no improvement in academic skills.

Table 3

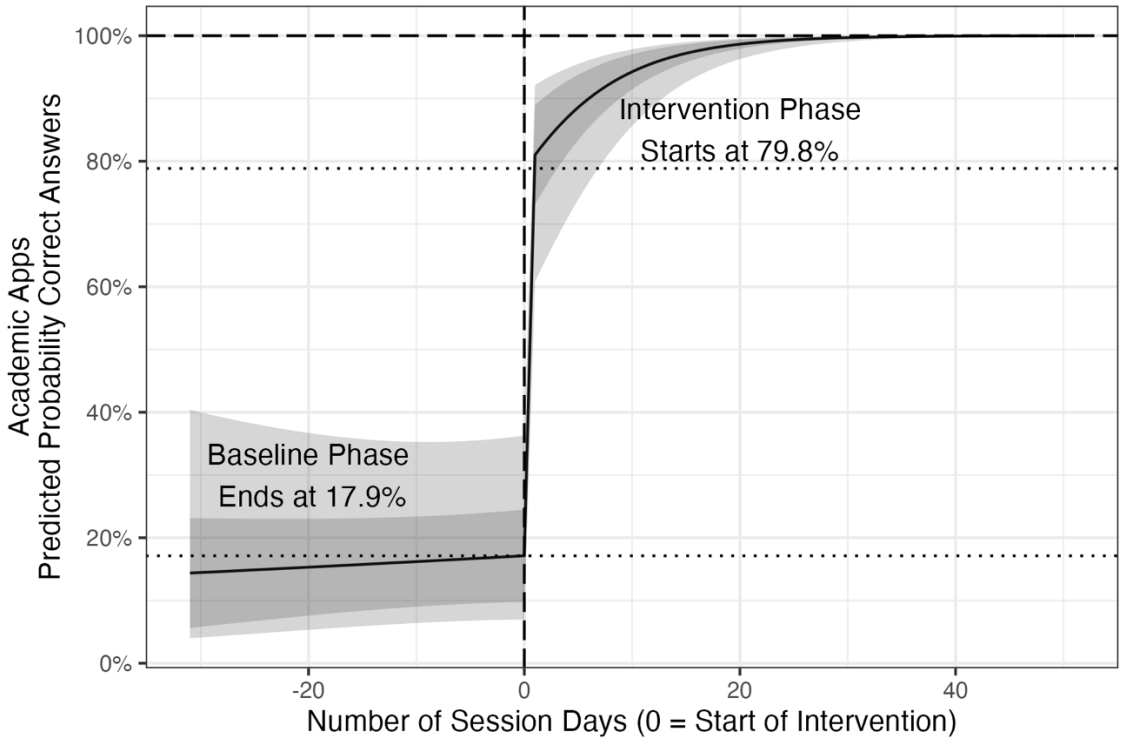
Parameter Estimates for Generalized Linear Mixed Effects Regression of Item Performance

	Beta			Exponentiated Beta		
Fixed Effects	*Est*	*(SE)*	*p*	*OR*	[95% CI]	
Intercept						
End of Baseline	-1.576	(0.517)	<.010**	0.207	[0.074,	0.576]
Start of Intervention	2.877	(0.099)	<.001 ***	17.762	[14.610,	21.593]
Average Change Per Session						
During Baseline	0.007	(0.018)	≥.050	1.007	[0.972,	1.042]
During Intervention	0.143	(0.020)	<.001 ***	1.154	[1.108,	1.201]
Random Effects	Var					
Participant within Study	0.328					
Domain	0.772					
Study	0.796					

Note. Model fit on 669 total sessions among 18 participants with 8 unique domains in 7 studies. ** $p < .010$. *** $p < .001$.

Figure 4

Marginal Plot for Generalized Linear Mixed Effects Model



Note. Confidence bands display both 95% confidence intervals with lighter shading and plus/minus one standard error from the mean (SEM) with darker shading.

Discussion

In this meta-analysis we examined the effectiveness of app-based academic interventions that were used with autistic children in the context of SCD studies. We also examined how specific moderator variables impact the effectiveness of app-based academic interventions. While other meta-analyses and reviews have looked at elements of technology-based and app-based interventions (Aspiranti et al., 2020; Hong et al, 2017; Kokol et al., 2019; Larwin and Aspiranti, 2019; Ledbetter-Cho et al., 2018; Petersen-Brown et al., 2019), this study adds to the literature by specifically examining SCD studies that use app-based academic interventions with children under 12 years.

SCD studies are well-suited to academic interventions and individuals with disabilities (Kratochwill et al., 2013; Shadish, 2014), and this study examines both. Overall findings from BC-SMD, LRR-i, and GLMM analyses indicated that app-based academic interventions helped preschool and elementary-aged autistic children improve their academic skills in several domains, including reading, mathematics, and science.

With between-study and within-study variability, it was important to examine study and participant moderators. Unfortunately, due to the small number of initial studies that were reduced further to multiple-baseline studies, the moderator analyses were largely underpowered and should be interpreted with caution; however, it is notable that all moderators examined (race/ethnicity, age, disability, and WWC study quality) impacted intervention effectiveness. While Indigenous, Latinx, Multiracial, Native Hawaiian/Pacific Islander, and White children all showed academic improvement from academic interventions, the single Black participant did not show significant academic improvement. This participant received a math problem solving intervention. As this was a single participant, this finding is not generalizable, but it does present an important challenge when designing app-based academic interventions for autistic children from various cultural backgrounds. App designers who create academic apps should consider how they can add culturally relevant components or how they can avoid elements that may be inappropriate in some cultures. For instance, some apps include creating an avatar, which should include a variety of options for children to choose so that their avatar resembles themselves (Fridenson-Hayo et al., 2017). Likewise, Ennis-Cole et al. (2013) suggested that technology interventions avoid the pitfalls of using phrases or symbols that may be offensive to some cultures. There are many possible reasons why

the app-based math intervention was not successful with the only Black child in this study, and it is crucial to consider that the app may not have had culturally responsive components that are important for intervention success (Davenport et al., 2018). Alternatively, the original study (Root et al., 2019) shows that this child did improve their mathematics skills, but their baseline data was relatively high from the start, indicating that there may have been a ceiling effect, and race was not a factor in the child's performance.

Age was another moderator that impacted intervention effectiveness. The app-based academic interventions worked somewhat better for preschool and kindergarten-aged children. However, there was no difference in statistical significance for children 6 years and younger and children ages 7 to 12 years. Overall, app-based academic interventions worked well for autistic children 12 years and younger. This aligns with previous research that has shown that greater benefits for younger autistic children with those older than 12 years showing diminishing returns from academic interventions as they age (McClain et al., 2021).

Disability was another moderator that affected the intervention outcome. While those with autism/Asperger's, autism and ADHD, autism and intellectual disability, and autism and other disabilities all showed academic improvement when using academic apps, a participant with autism and a speech-language impairment did not show significant improvement with the intervention. The skill the app targeted was number identification. Although it may appear surprising that an autistic child with language challenges would have difficulties with math learning, children with speech-language impairments often have additional struggles with mathematics due to differences in

cognitive processing (Alt et al., 2014). Moreover, many autistic children may have challenges with several elements of mathematics (May et al., 2015; Whitby & Mancil, 2009). The compounded math challenges this child may have faced with a speech-language impairment, as well as any possible language loading with the app itself, may have made an academic app-based intervention less successful for this child. A meta-analysis that examined SCD reading comprehension interventions for autistic children also found that children with autism and a speech-language impairment had challenges with academic improvement as compared to children with autism only (McClain et al., 2021).

Finally, the WWC study quality findings showing that studies that met criteria and studies that did not meet criteria were both statistically significant, while studies that met with reservations did not quite reach significance, is puzzling. This finding may be an issue of being underpowered, as the data appear to be trending toward significance. Another explanation could be that studies that meet with reservations may not have as many data points as studies that fully meet the WWC criteria. In addition, studies that did not meet criteria were nearly always labeled this way due to poor descriptions of inter-rater reliability rather than a lack of sufficient data points. They very well may have met full criteria if the inter-rater reliability was described in full so that it was clear that they had inter-rater reliability on 20% of data points for each participant and in each phase (Kratochwill et al., 2013). Researchers who conduct single-case design studies should be aware of that they need to fully describe their inter-rater reliability practices, as we found that many studies did not meet criteria based on poor reporting practices.

Limitations and Future Research

One of the largest limitations to this meta-analysis is the sample size. Out of an extensive search across common psychology and education databases, only 12 articles met the search criteria. Out of those, primarily articles with a multiple baseline design could be used in the analyses, as most alternating treatments studies had no baseline measurement. While some alternating treatment designs may have a condition that a researcher could use as a baseline, the alternating treatments designs found in this study either compared two apps or an app and an app with an additional treatment, making it impossible to decide which would act as baseline and which would be the intervention phase. We also eliminated studies with other designs that could not be fully and accurately represented in the data analysis. While the primary analyses (BC-SMD, LRR-i, and GLMM) all had sufficient samples, the moderator analyses were largely underpowered. Due to this, the findings from the moderator analysis should be interpreted with caution and are not generalizable. Another limitation to the analyses was the BC-SMD analysis either required participant measurements alone or participant measurements and domain together. As academic domain contributed to a large amount of variability between studies, participant and domain were added together to create a larger group size, but this type of analysis did not allow for domain alone, which slightly altered results on the intervention effectiveness. This analysis was chosen because of prior research recommendations related to SCD meta-analyses (Shadish et al., 2015), but it presented some limitations. Likewise, though all interventions were app-based and academic in nature, most looked at different academic areas, used different apps, and generally were not uniform, creating significant variability. Additionally, we only included children ages 3-12, which allowed us to focus on children in preschool and

elementary school, but also made us exclude studies with older children that could have been used in the meta-analysis. Although our research and others (McClain et al., 2021) indicated that children over 6 years old had less success with academic apps, future research should examine if academic apps work for secondary school students, even if it may be to a lesser degree. To combat publication bias, we conducted the search and included dissertations and conference proceedings. However, there is a chance that there are other unpublished manuscripts that we were unable to retrieve, and a funnel plot indicated that there is some potential for publication bias. Therefore, it is possible that our findings are inflated.

Future research, such as updating the present meta-analysis, should aim to address the limitations noted above. Primarily, it is important to continue to conduct research and publish studies that measure the effectiveness of academic apps with autistic children. As shown in this meta-analysis, the present research base is limited. Apps are a promising technology that are generally affordable, portable, and appealing to the autistic mind (Ferrari & Suzanne, 2017). Researchers should continue to examine how schools, teachers, and parents can implement app-based academic interventions with children with autism using single-case design methodology. In addition, it is vital that app creators incorporate culturally responsive content in academic apps, and educators choose apps that are appropriate for minoritized populations. Similarly, researchers should continue to build a body of literature on academic apps with diverse samples, as the studies contained in this meta-analysis were primarily made up of White participants. Indeed, research shows that there is little racial and ethnic diversity in autism intervention studies in general, which is highly problematic (Harris et al., 2020), and this study aligns with those

findings. More research is also needed to determine which academic apps may be best suited for children with autism as compared to children with autism and a speech-language impairment. Likewise, researchers should study why older children may benefit less from academic apps. This may include examining if academic apps are developmentally appropriate for older children or if older children's academic material is more challenging, so they need more time to learn and master the material. Overall, this area of technology as an intervention is still emerging, and further research is needed to fully explore the effectiveness of academic apps with autistic children.

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* Indicates a study used in the meta-analysis

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CHAPTER III

AN APP-BASED EARLY ACADEMIC SKILLS INTERVENTION FOR CHILDREN WITH AUTISM

The second manuscript is titled *An App-Based Early Academic Skills Intervention for Children with Autism*. The authors are Cassity R. Haverkamp, Megan E. Golson, Maryellen Brunson McClain, and Sarah E. Schwartz. The manuscript is currently being prepared with minor revisions for re-submission to Contemporary School Psychology. A prior version of this manuscript was presented in February 2020 at the Association of School Psychologists Annual Convention in Baltimore, MD. While I use the medical term "autism" in all other sections of the manuscript, this chapter uses the special education eligibility categories of "Autism (AU)" and "Developmental Delay (DD)" to refer to children with autism, as it focuses on children in schools and special education.

Introduction

Children receiving special education services under the Autism (AU) and Developmental Delay (DD) special education eligibility categories account for 17% of students who receive special education in public schools (National Center for Education Statistics, 2019). When identified early, these students often receive services that target speech and language, motor abilities, and social skills. Within the preschool setting, academic concerns are also paramount for students with AU and DD, as they are likely to have later difficulties in core areas such as reading and mathematics (Keen et al., 2016; Wei et al., 2014).

For children in the AU category, later reading comprehension skills may be particularly impacted (Mayes & Calhoun, 2008; McIntyre et al., 2017; Nation et al., 2006; Whitby & Mancil, 2009). Reading fluency and oral language skills are also

important early abilities in children in the AU category, as they are strong predictors of later reading comprehension skills (Davidson et al., 2018; Nation & Norbury, 2005; Solari et al., 2017). Children with DD may experience similar reading difficulties, particularly when they are delayed in the areas of motor and language development (Shevell et al., 2005). Early predictors of reading ability in young children in the AU category include nonverbal cognitive abilities and letter sound knowledge (Westerveld et al., 2018). Emergent literacy skills also depend on abilities such as phonological awareness and alphabet knowledge, areas where children with AU and DD may be delayed (Westerveld et al., 2017).

Similarly, children in the AU and DD categories have difficulties in some areas of mathematics (e.g., Aagten-Murphy et al., 2015; Shin et al., 2013; Wei et al., 2012; Whitby & Mancil, 2009). In a review of the literature, Whitby & Mancil (2009) found that children in the AU category may have more difficulties with complex problem solving, multi-step problems, and story problems. Wei and colleagues (2012) found that children in the AU special education category had a slower trajectory for math learning growth than their typically developing peers in both calculation and applied problems. Attention difficulties commonly found in children in the AU category can also play an important part in math learning (May et al., 2013, 2015; Whitby & Mancil, 2009). Importantly, gaps in math gains between typically developing children and those receiving special education services remain in the late elementary education years (Shin et al., 2013; Wei et al., 2012). Titeca and colleagues (2014) found that in the preschool years, subitizing and counting predicted better mathematics outcomes in first grade for children in the AU category. Researchers have reported that about 22-23% of children

with a clinical diagnosis of ASD also meet diagnostic criteria for a specific learning disorder in math (Mayes & Calhoun, 2006; Oswald et al., 2016).

Technology Interventions for AU and DD

With advancements in computer technology, many education professionals are using computer-based interventions for children with AU or DD (Hong et al., 2017; Kagohara et al., 2013). Likewise, research has shown children with AU typically prefer interventions implemented through computers and electronic tablets, and they are practical and convenient for teachers (Baron-Cohen, 2006; Neely et al., 2013). Most interventions for children with AU that implement computer technology are focused on learning social, adaptive, and requesting skills rather than academics (Hong et al., 2017; Kagohara et al., 2013), even though it has been noted that many children with ASD have difficulties in the areas of reading and mathematics. Although research has shown that children with ASD prefer interventions implemented via computer technology, there is little empirical research to show the effectiveness of these interventions in teaching academic material to children with ASD. Of note, preliminary research has shown improvement in areas such as spelling and numeracy (Jowett et al., 2012).

Since the inception of tablets in 2010, making portable touch devices more accessible to the public, more technology research has focused on tablets and apps as intervention tools in school settings (Elicin & Kaya, 2017). Teachers and families can now easily access a multitude of educational apps with varying costs and targeted skills (e.g., literacy, communication, math, science, on-task behavior). Review papers and meta-analyses have shown that many interventionists choose to create their own materials and present them via a tablet than use commercially available apps when it comes to

teaching academic skills to children in the AU category (Hong et al., 2017; Ledbetter-Cho et al., 2018). What is concerning about the use of app-based interventions is that most do not have a strong evidence base, yet they are frequently recommended by education professionals for use at school and home (Kokal et al., 2019; Larwin & Aspiranti, 2019; Stone-MacDonald, 2015). Meta-analyses of app-based academic interventions for children with AU and other disabilities indicate that these types of interventions show promise, but frequently include few studies directly examining the overall effectiveness of tablet apps (Aspiranti et al., 2020; Hong et al., 2017; Larwin & Aspiranti, 2019; Ledbetter-Cho et al., 2018). As app-based academic interventions for children in the AU and DD categories may be most useful for preschool-age children, the dearth of research using app-based interventions with younger populations is surprising (Griffith et al., 2020).

The Current Study

Children within the AU and DD categories often show more academic difficulties than their same-age peers in the core areas of literacy, reading, and math, yet this aspect of intervention is frequently overlooked due to possible social skills deficits, communication problems, poor motor skills, or disruptive behavior problems. Because children in the AU and DD categories are at risk for later academic difficulties, ensuring that these children receive early intervention in core academic areas is important for continued academic success throughout their time in school. App-based tablet applications are a practical and affordable method to delivering such interventions in the school setting. They require little teacher input, are engaging for children with AU and DD, and apps are typically cost-effective tools. However, the lack of research on the use

of app-based academic interventions for children in the AU and DD categories may hinder teachers and education professionals from choosing this method of intervention. To address this gap in the literature, the current paper presentation will examine the effectiveness of an app-based tablet intervention for letter and number learning with young children with ASD as well as its effect on school readiness. This study aims to answer the following research questions:

1. Is the LetterSchool© app an effective intervention for teaching uppercase letters (A-Z) to children in the AU or DD special education categories?
2. Is the LetterSchool© app an effective intervention for teaching lowercase letters (a-z) to children in the AU or DD special education categories?
3. Is the LetterSchool© app an effective intervention for teaching numbers (1-10) to children in the AU or DD special education categories?
4. Will children in the AU or DD special education categories be able to correctly identify more letters and numbers when asked to use expressive or receptive language?
5. Will school readiness increase from pre- to post-intervention when children in the AU or DD special education categories use the LetterSchool© app?

Method

Participants and Setting

Five preschool students, their caregivers, and their teacher participated in the current study. All child participants were 4 years old at the beginning of the study and received instruction in the same special education preschool classroom four days per week. Christopher and Ethan (all names used in this study are pseudonyms) were White males receiving special education services under the Autism eligibility category. Gavin,

York, and Shawn were White males receiving special education services under the Developmental Delay eligibility category. The intervention was conducted during morning and afternoon special education preschool classroom sessions in the same classroom with the same teacher and aids. Each student was either in the morning or afternoon classroom and received the intervention only during the time they were in class. The intervention was provided outside of core instruction times. The interventionists used a small occupational therapy room at the back of the classroom, a table near the back of the classroom, or a quiet hallway during intervention sessions to minimize distractions.

Materials and Measures

Demographic Form

Prior to the intervention, parents received a packet with the informed consent form and a brief demographic measure (Appendix C). The demographic measure included information such as child age, race/ethnicity, date of birth, special education eligibility, and any prior diagnosis of autism spectrum disorder (ASD) by an outside professional. The participants' teacher also completed a brief demographic questionnaire that indicated her age, race/ethnicity, and how long she had known each of the participating students.

LetterSchool© Application

The LetterSchool© application (Letterschool Enabling Learning B.V., 2018) is an iOS application that teaches uppercase letters, lowercase letters, and numbers through repetition and tracing using a step-by-step process. While this app was not specifically designed for children with autism, the researcher chose this app because of its predictable

patterns (i.e., present the letter/number, tap, trace, draw) and rewards that appeared to align with interests of young children with autism. For instance, rewards on the app included a train with noises that would follow the outline of number of letter and bubbles with popping noises that outlined the number or letter. The app also appeared user friendly, and young children could generally use the app independently. The application is designed to teach uppercase and lowercase letter sounds and names, counting from 1 to 10, writing letters and numbers, and fine motor skills. During sessions, the app first tells the child what the letter or number is, then children tap the dots connecting the structural components of letters or numbers, then trace the letter or number with supports from the app (e.g., arrows to show the direction the child should trace, lights up the next structural component), and then write the letter or number with minimal supports from the app (e.g., gives an arrow to show the next line only if the child does not immediately begin or does not draw the line correctly). When children successfully complete a step, the app provides a reward (e.g., animation of a train tracing the letter, bubbles, confetti).

Bracken Basic Concept Scale – Third Edition: Receptive (BBCS-3:R)

The BBCS-3:R measures auditory comprehension of foundational concepts, including knowledge of uppercase and lowercase letters and numbers. The BBCS-3:R includes the School Readiness Composite (SRC), which is made up of the colors, letters, numbers/counting, sizes/comparisons, and the shapes subtests. The SRC examines concepts needed for early education beyond the preschool years and may also be used as a screener to determine a child's level of school readiness. The School Readiness Composite (SRC) was used as a measure of school readiness in the current study and includes a composite score that is a standardized score based on age norms of

other children in the same age range. The researchers also determined that the raw scores would be important for individual comparisons from pre- to post-intervention because the participants had known developmental delays. The BBCS-3:R test-retest reliability indicates that the test has good reliability across age bands, with the SRC showing a good corrected stability coefficient (r^b = .84). The SCR also shows excellent internal consistency reliability, with scores from .82-.98 across age groupings, gender, and race/ethnicity. The BBCS-3:R also shows good validity as evidenced by intercorrelation analyses with the PLS-4.

Following parent/caregiver consent, The BBCS-3:R was administered to each participant before starting baseline data collection. Following the intervention, the BBCS-3:R was again given to each participant to determine gains in school readiness. The BBCS-3:R was used as a pre-post measure to examine student school readiness in receptive areas, as these students were preparing to enter Kindergarten the following year. The SRC score (both raw and composite/standard scores) was calculated prior to baseline and after completing the intervention. During the second administration, the researchers used the new age norms for each student, as they had all turned five during the intervention.

Intervention Materials

The interventionist used the following materials for accurate and consistent intervention implementation: (a) an iPad© that was compatible with the LetterSchool© application, (b) a data sheet for the interventionist to check off the intervention steps (to insure fidelity), (c) a progress monitoring data collection sheet to mark correct/incorrect for receptively and expressively identifying target numbers and letters, (d) letter and

number flashcards for progress monitoring, (e) a pencil or pen, and (f) a video camera to record baseline and intervention sessions for an outside observer to calculate inter-rater reliability and intervention fidelity.

Procedure

Researcher Training

The first author trained a graduate research assistant in single-case design methodology and the implementation of a multiple-baseline intervention. The researchers then discussed and practiced implementing the baseline and intervention procedures of the intervention while using the fidelity checklist and data tracking forms. The first author provided the intervention to three participants (Ethan, York, and Shawn), and the second author provided the intervention to two participants (Christopher and Gavin). An undergraduate research assistant was also trained on the baseline and intervention procedures to conduct inter-observer agreement and intervention fidelity checks from the recorded sessions.

Participant Recruitment

The first author contacted several local school districts' mental health professionals who disseminated the study information among special education preschool teachers. One teacher responded to the research request. She recommended five students who she believed would be good fits for the study and would benefit from participation in this intervention.

Baseline Phase

The researchers collected baseline data on uppercase and lowercase letters and numbers prior to implementing the intervention. The same procedures were used to

measure letter and number learning in the baseline and the intervention phases. Five target uppercase and lowercase letters and five numbers were randomly chosen for each baseline session. Randomly identified letters ranged from A to Z and randomly identified numbers ranged from 1 to. 10. For each target letter or number, the researchers examined both expressive and receptive language presentations. To determine expressive language, researchers asked, "What letter/number?" The child would then respond expressively (e.g., "A"). To determine receptive language, researchers randomly selected three letter or number cards and asked, "Touch letter/number" (e.g., "Touch A"). Participants then pointed to one of the three options. Data were collected for each target uppercase or lowercase letter and number across a minimum of five sessions to establish a stable baseline and meet What Works Clearinghouse SCD standards (Kratochwill et al., 2010). Data were collected two times per week.

Intervention Phase

After at least five baseline data points showing baseline stability, the researchers implemented the LetterSchool© application intervention. Researchers implemented the intervention, which took 7 minutes to complete, two times per week. Students were able to independently choose letters and numbers to learn and trace. This method was used because this is likely what would occur in a classroom or home setting. Researchers were available to students during the intervention, but they did not actively engage with the students during the intervention period, as the app itself provides all direct intervention materials with which the student engages. After the intervention time was complete, researchers engaged in progress monitoring on upper and lowercase letter and number learning. Progress monitoring followed each intervention session. Researchers showed

students numbers and letters flashcards to measure expressive and receptive letter and number knowledge. For each session, five randomly assigned uppercase and lowercase letters and five numbers were assessed during progress monitoring. Five targets were chosen due to the length of time needed to provide the intervention and progress monitor both expressive and receptive language. All children completed at least five intervention sessions to meet criteria for WWC standards (Kratochwill et al., 2010).

Interobserver Agreement (IOA) and Intervention Fidelity

A trained undergraduate served as the outside observer. They watched and scored 30% of recorded sessions for each participant during the baseline phase. Similarly, the outside observer watched and scored 30% of recorded intervention sessions for each participant (Kratochwill et al., 2010). Based on separately scoring the progress monitoring data and checking the fidelity checklist, the researchers calculated inter-observer agreement (IOA; Kratochwill et al., 2010). IOA is calculated by determining the number of agreements and disagreements between the interventionist and the outside observer. The total number of agreements was divided by total agreements and disagreements. This was then multiplied by 100 to create a percentage. They also determined intervention implementation fidelity based on the outside observer's completed fidelity checklists. IOA for all baseline conditions was 99% and ranged from 93-100% within sessions. For the intervention sessions, IOA was 100%. The outside observer rated intervention fidelity at 100%.

Design

The researchers used a nonconcurrent multiple baseline single-case design (SCD) to determine the functional relation between the independent and the dependent variables.

The independent variable was the LetterSchool © app. The dependent variable was the percent correct on five trials each for uppercase and lowercase letters and numbers 1-10 when progress monitored, using receptive and expressive language, after an intervention session.

Data Analytic Plan

Visual Analysis

To determine a functional relation between the app-based intervention and the dependent variables, the researchers conducted visual analysis by examining changes in level, trend, variability, and immediacy of the effect (Kratochwill et al., 2010).

Generalized Linear Multilevel Modeling (GLMM)

In addition to the visual analysis of the effect variables, including additional sessions, expressive vs. receptive conditions and intervention targets (uppercase and lowercase letters and numbers) were quantifiably assessed via an inferential model like regression analysis for interpretation. Prior to modeling, descriptive statistics and corresponding visualizations explored the relationship between the independent (intervention) and dependent (percent correct on number and letter tasks) variables.

Mixed-effects logistic regression or a generalized linear multilevel model (GLMM) was used to further examine the effects of the intervention on learning uppercase letters, lowercase letters, and numbers (Onghena et al., 2018). This approach combines aspects of several common techniques. First, like logistic regression, it models binary outcomes (correct vs. incorrect) dependent on any combination of continuous and categorical variables (Onghena et al., 2018). Second, like repeated measures analysis of variance (RM ANOVA), observations are treated as being nested or clustered instead of

assuming independence (Aiken et al., 2015; Onghena et al., 2018; Shadish et al., 2014). Additionally, this approach may incorporate a more complex natural hierarchy of observation nesting. This is advantageous since the repeated measurements inherent to a multiple-baseline single-case design are nested at three levels as illustrated in Figure 5. Individual responses to stimuli comprise the unit of the lowest level (level 1 units). Both condition (uppercase letters, lowercase letters, and numbers) as well as presentation (expressive and receptive) were predictors specific to responses at this level. These observations are clustered within a given session (level 2 units) which was further nested within participant (level 3 units).

Since each participant had a potentially unique number of baseline sessions prior to the intervention, session number was centered such that the last baseline session was number zero and intervention sessions numbered sequentially with positive numbers (1, 2, 3, …) whereas baseline sessions were reverse numbered (…-3, -2, -1, 0), as seen in Figure 6. This allows the interaction between session number and intervention indicator to capture the potential immediate effect of the intervention. In addition to this factor, trends within baseline and intervention phases were investigated after controlling for the potential differences in accuracy between the combinations of presentation and condition.

Significance of predictors (fixed effects) was determined via chi-squared likelihood ratio tests (LRT) of nested models instead of standard regressions Wald t-test (Hox et al., 2019). The final model is visually presented via a marginal means plot. There were no missing data due to the nature of the design. All statistical analyses were conducted in R 3.6.3 (R Core Team, 2020) utilizing the “lme4” package (Bates et al., 2015).

Results

All participants' data across baseline and intervention phases are represented in Figures 3-8. The horizontal axis represents the session number. The vertical axis represents the number of correct responses out of five trials.

Pre-Post Intervention School Readiness

Observed scores from the BBCS-3:R for all participants are provided in Table 4. Prior to the intervention, Christopher's standardized (composite) score was in the Average range on the BBCS-3:R. Christopher's school readiness composite decreased post-intervention and fell in the Delayed range. This may be because he moved into an older age norm group when data were collected post-intervention. Hence, Christopher's raw scores may be a better estimate of his abilities pre- and post-intervention. Christopher's raw score pre-intervention was a 46, and his raw score post-intervention was a 43, only a three-point difference, indicating that he did not make any significant gains in school readiness after the intervention.

Based on the standardized score (composite score), Gavin scored in the Delayed range on the BBCS-3:R pre-intervention. His composite score remained in the Delayed range post-intervention since he had also moved into new age norms. When examining his raw scores, notably, Gavin answered more questions correctly post-intervention. He earned a raw score of 32 on the BBCS-3:R pre-intervention in comparison to a 37 post-intervention.

On the general composite, Ethan scored in the Very Delayed range pre-intervention using a standard score. Ethan's school readiness composite increased slightly post-intervention. However, this increase was not significant enough to move his score

out of the Very Delayed range based on standard scores. Ethan's raw score prior to the intervention was a 0, as he did not answer any items correct the first time he took the test. Post-intervention, Ethan was able to answer some questions giving him a raw score of 4 and indicating minimal improvement in school readiness.

Prior to baseline data collection, York scored in the Delayed range on the BBCS-3:R composite (standard score). After the intervention ended, York received the BBCS-3:R again, and his composite score decreased, falling in the Very Delayed range after the intervention because he had moved into an older age norm by the end of the intervention. When examining his raw scores, York received a 35 prior to the intervention and a raw score of 24 after the intervention, indicating no progress in school-readiness.

Finally, before data collection, Shawn scored in the Delayed range on the BBCS-3:R composite (standard score). Shawn's standard score on the BBCS-3:R did not increase after the intervention, and he remained in the Delayed range even though he moved into an older age norm at the end of the study. Shawn's raw score prior to the intervention was a 43, and after the intervention he received a raw score of 34. Shawn's school readiness scores did not increase post-intervention.

Visual Analysis

Figures 7-12 visually represent the baseline and intervention data for uppercase, lowercase, and number learning.

Christopher

Uppercase Letters. In the baseline phase for receptive uppercase letters, Christopher was frequently able to identify most or all letters. Christopher's lowest score for receptive language was two correct out of five items. This trend did not change when

the intervention was introduced, with similar scores in both phases. For expressive uppercase letters, Christopher had slightly lower scores than his receptive language in both the baseline and intervention phases. Christopher evidenced no improvement in expressive uppercase letters after the start of the intervention. Regarding Christopher's expressive knowledge of uppercase letters, there was no observed change in median level for expressive responses from baseline to intervention. His receptive responses decreased from a median of two items correct at baseline to a median of one item correct at intervention. There was no immediacy of change for either uppercase letter condition, as Christopher showed no improvement in these conditions. Variability decreased in the intervention phase for both expressive responses (Range=0-2 correct) and receptive responses (Range=2-4 correct). Additionally, during the intervention, Christopher's uppercase letter learning had a downward trend for both receptive (-0.08) and expressive (-0.03) conditions. Based on visual analysis, there were no clear increases in uppercase letter learning from baseline to intervention.

Lowercase Letters. Regarding lowercase letters, Christopher's receptive scores in baseline were inconsistent (2-5 items correct), with no apparent improvement with the introduction of the intervention. Expressive lowercase scores were slightly lower and less variable, and they plateaued in the intervention phase, although there was no improvement between phases. As for lowercase letters, an increase in median level was noted for receptive responses, from two items correct at baseline to three items correct at intervention. No change in level was seen in the expressive condition. Likewise, there was no apparent immediacy of change from baseline to intervention. Variability for lowercase letters decreased during the intervention phase for both receptive (Range=1-4

correct) and expressive responses, which were consistently one answer correct per session. While the expressive responses changed from a downward trend to a plateau (0), receptive responses changed from a downward trend to a slight increasing slope (0.01). Overall, visual analysis did not show increases in lowercase letter knowledge from baseline to intervention.

Numbers. Christopher's receptive number identification was consistently high throughout data collection with a noted ceiling effect in both phases. Christopher's expressive number identification was slightly lower than its receptive counterpart. Progress monitoring with numbers indicated a slight decrease in median level for both expressive (four correct at baseline to three correct at intervention) and receptive (five correct at baseline to four correct at intervention). There was no observed immediacy of change, as Christopher exhibited a high number of correct responses in the baseline phase in both expressive and receptive presentations. Expressive responses were slightly less variable from baseline to intervention (Range=1-4 correct). Receptive responses, conversely, increased in variability (Range=3-5 correct). Slopes for both expressive (0.02) and receptive (0.05) presentations of the numbers task were small and positive. Taken together, these results do not suggest the intervention resulted in increases in expressive or receptive numeracy skills.

Gavin

Uppercase Letters. In the baseline phase for receptive and expressive uppercase letters, Gavin was typically able to label at least one letter. This trend continued into the intervention phase, with no apparent change. Of note, the receptive presentation appeared less difficult for Gavin. Regarding Gavin's ability to identify uppercase letters, there was

a change in level for both his receptive and expressive scores, though the median scores decreased from baseline to intervention. There was no immediacy of change for either uppercase letter condition. Gavin's scores on both receptive (Range=1-3 correct) and expressive (Range=0-1) upper-case letters were somewhat stable in variability during the intervention phase. While expressive scores for uppercase letters resulted in a plateau (0), receptive scores had a slightly negative slope in the intervention phase (-0.11). Overall, Gavin's scores remained very similar between baseline and intervention, with no clear effect of the intervention.

Lowercase Letters. Gavin evidenced a similar pattern for lowercase letters as uppercase letters, with no apparent increase from baseline to intervention and with the receptive presentation proving to be less difficult for Gavin. The median for Gavin's lowercase letters remained the same between baseline and intervention for receptive learning and decreased by one item correct from baseline to intervention. There was no apparent immediacy of change for either presentation. Variability in Gavin's scores decreased over time with expressive scores ranging from zero to one item correct and receptive scores ranging from one to three items correct during the intervention. Both receptive (-0.10) and expressive (-0.04) conditions for lowercase letters had a slightly decreasing trend. From these findings, there does not appear to be a significant increase in learning lowercase letters from baseline to intervention.

Numbers. At baseline, Gavin did exceptionally better with the receptive presentation than in the expressive presentation. Gavin did not appear to increase in any of the targeted academic areas. Gavin's scores of number knowledge had no change in median expressive score from baseline to intervention, but his receptive scores increased

from a median of one and a half to two items correct at intervention. Only receptive scores increased immediately from 0 to 3 items correct at the first intervention session, but Gavin's receptive scores for number knowledge were highly variable (Range=0-3 correct), suggesting little to no change. Expressive scores maintained the same range of variability from baseline to intervention (Range=0-1 correct). Both the receptive (0.01) and expressive (0.16) presentations had a slight and positive trend for number learning. Taken together, there is no evidence number knowledge increased from baseline to intervention in either receptive or expressive conditions.

Ethan

Uppercase Letters. Ethan's understanding of uppercase letters did not increase from baseline to intervention. In fact, Ethan remained consistently low with both receptive and expressive presentations. Regarding Ethan's knowledge of uppercase letters, there was no observed change in median level for expressive and receptive responses from baseline to intervention. There was also no immediacy of change for uppercase letters in either receptive or expressive presentations. There was no variability in the expressive presentation and little variability in the receptive (Range=0-1 items correct). During the intervention, Ethan's uppercase letter learning had a downward trend for receptive (-0.09), and his expressive learning scores plateaued. Ethan experienced such difficulty in attending to material during the intervention and progress monitoring, his scores were all near zero, and there was no evidence that the intervention had an effect for Ethan's uppercase letter knowledge.

Lowercase Letters. The uppercase letters trend was similar for lowercase letters, with consistently low scores in both baseline and intervention conditions. Ethan had

slightly more correct responses in the receptive presentation for both letter conditions than the expressive presentation. Ethan's lowercase letter learning showed a decreased mean from baseline to intervention for receptive learning and no change in median for expressive learning. Likewise, there was no apparent immediacy of change from baseline to intervention for Ethan's lowercase letter learning. There was little variability in Ethan's scores during the intervention phase, ranging from zero to one item correct in each session for both receptive and expressive presentations. The trend for Ethan's lowercase letter learning slightly increased for the receptive presentation (0.13), but there was a downward trend in the expressive presentation (-0.09). Ethan's overall scores based on visual analysis do not appear to show an increase in lowercase letter knowledge from baseline to intervention.

Numbers. Ethan's receptive and expressive number identification appeared to improve from the baseline to intervention phase. Ethan was not able to identify any numbers during the baseline phase for either expressive or receptive presentations. However, this improvement was minimal and highly variable. Finally, Ethan's progress monitoring scores for numbers indicated an increase in the median for the receptive presentation, moving from zero items correct in baseline to one item correct during intervention. The median stayed the same between baseline and intervention for the corresponding expressive presentation. There was no observed immediacy of change after the start of the intervention for either presentation. The baseline variability was stable for Ethan's number learning, and the intervention phase was highly variable for both expressive (Range=0-4 items correct) and receptive responses (Range=0-2 items correct). Slopes for both expressive (0.03) and receptive (0.01) presentations of the

numbers task were small and positive. While visual analysis shows that Ethan increased his number knowledge, this increase was minimal.

York

Uppercase Letters. For uppercase letters, York showed a clear increase from baseline to intervention for the receptive presentation, although this change ended in a plateau of learning. For expressive uppercase letters, York also had a slight increase in scores from baseline to intervention, although there was significant overlap in scores in baseline and intervention. With uppercase letters, York's the median scores for uppercase letters increased from one correct to three correct. However, there was no observed change in median level for expressive responses. York's receptive scores for uppercase letters showed an immediacy of change right after the start of the intervention. Unfortunately, this increasing trend did not continue and plateaued. For the expressive language presentation, there was no immediacy of change. There was no variability for receptive learning in the uppercase condition and there was little variability in the expressive learning presentation (Range=1-2 items correct). During the intervention phase, York's uppercase letter scores had a downward trend for expressive (-0.06) learning. Based on visual analysis, York appeared to gain some skills in receptively recognizing uppercase letters, although he did not continue to improve with more intervention sessions.

Lowercase Letters. Lowercase letter learning did not show the same increase as uppercase letters. There was no clear difference between baseline and intervention. York showed an increase in median level for expressive responses, from 0 items correct at baseline to one item correct at intervention. No change in median was seen in the

receptive presentation. There was no apparent immediacy of change from baseline to intervention for either language presentation. Variability for lowercase letters decreased during the intervention phase for receptive (Range=1-3 items correct) and stayed the same for expressive responses (Range=0-1 items correct). The trend for lowercase letters was downward for both expressive responses (-0.08) and receptive (-0.05) presentations. Based on visual analysis, there was no change from baseline to intervention for learning lowercase letters using expressive and receptive language.

Numbers. Similar to lowercase letters, there was no clear increase from baseline to intervention for number learning. Of note, York's scores were typically better for receptive language. Progress monitoring with numbers indicated a slight increase in median level only for the receptive presentation (four correct at baseline to five correct at intervention). The median did not change for the expressive numbers condition. There was no observed immediacy of change. Both expressive (Range=0-3 items correct) and receptive (Range=2-5 items correct) responses were highly variable in both baseline and intervention phases. However, slopes for both expressive (0.02) and receptive (0.01) presentations of the numbers task were small and positive. Overall, York showed an increase in receptively identifying numbers, but his expressive identification remained stable from baseline to intervention.

Shawn

Uppercase Letters. When examining Shawn's scores for uppercase letters, there appeared to be no change from his baseline to intervention phase for both receptive and expressive presentations. Regarding Shawn's knowledge of uppercase letters, there was no observed change in median level for either receptive or expressive responses. There

was no immediacy of change for either uppercase letter condition. Variability decreased in the intervention phase for uppercase letters for both expressive responses (Range=1-2 items correct) and receptive responses (Range=1-3 correct). While receptive scores had a downward trend (-0.02), expressive scores had a slight upward trend (0.08). There was no clear increase in skills from baseline to intervention in either the receptive or expressive language condition.

Lowercase Letters. There was a similar pattern between Shawn's uppercase and lowercase letters. Notably, Shawn had one outlier baseline session where he was able to identify all lowercase letters asked for the receptive condition, but he was unable to identify those same letters expressively. With lowercase letters, there was a decrease in median level for receptive responses, from two items correct at baseline to one item correct at intervention. The median did not change for the lowercase letters expressive condition. As with uppercase letters, there was no apparent immediacy of change from baseline to intervention. Variability scores increased for the expressive language presentation (Range=0-2 items correct) and decreased during the intervention phase for receptive (Range=1-2 items correct) responses. In line with these findings, the trend for receptive lowercase letter responses had a slight decreasing slope (-0.08), and the expressive responses had a slight increase (0.05). Based on the data, there was no clear increase in understanding lowercase letters from baseline to intervention.

Numbers. Shawn's receptive number learning appeared to have an increase over time, although his baseline data for this condition was highly variable. Progress on expressive number learning did not appear to increase from baseline to intervention. Progress monitoring with numbers indicated a slight increase in median level for both

expressive (one correct at baseline to two correct at intervention) and receptive (two correct at baseline to three correct at intervention). There was no observed immediacy of change in the number conditions. Variability was similar between baseline and intervention for number conditions (Expressive Range=1-3; Receptive Range=2-5). The slope for the receptive numbers condition had an increasing trend (0.07), while the expressive numbers condition varied in a way that there was no definitive slope. Based on the data, Shawn appeared to gain some number knowledge from the intervention, although these gains were minimal.

Generalized Linear Multilevel Model (GLMM)

Table 5 details the parameter estimates for the three-level Logistic GLMM model for accuracy across session, intervention, condition, and presentation. Experimental phase, representing a change from baseline to intervention, was not significant, LRT $\chi^2(1) = 0.163$, $p = .686$. However, a phase by presentation interaction with a main effect for condition was a significantly better fit than a main effects only model, LRT $\chi^2(1) = 1.615$, $p < 0.001$. While this was the best fit model, we decided to include a main effect of sequenced time from baseline to intervention in the final model because it is a theoretically important part of single-case design, LRT $\chi^2(1) = 0.067$, $p = 0.795$. Accuracy for the receptive presentation was globally better than expressive language across conditions as depicted in Figure 13. Performance on the number condition was better than either uppercase or lowercase letter conditions. Of interest, there was no significant time trend in either the baseline or intervention phases, $p = .794$, and no overall effect of intervention, $p = .367$.

Discussion

This study examined the effects of the LetterSchool© app on helping preschool-age child in the AU and DD special education categories learn uppercase and lowercase letters (A-Z) and numbers (1-10). This study used a multiple baseline SCD methodology to show the effect of the intervention from the baseline phase to the intervention phase. Based on the results from both visual analysis of the SCD data graphs and a GLMM analysis from all five participants, this app-based academic intervention did not conclusively increase letter and number knowledge in young children with AU or DD. There was no immediacy of change when the intervention started, nor did the trend or median show a significant increase. While these children were more likely to do better overall on receptive language presentations (e.g., pointing to one of three possible options) than expressive language presentations (e.g., asking child to verbally state letter or number name) and on identifying numbers, there was no intervention effect and no change from the baseline phase to the intervention phase.

There are several possibilities as to why the intervention may have been ineffective. One possible reason is the length of the intervention. One possible reason for the ineffectiveness of the intervention was attention towards the app itself. The app was initially engaging for participants, but the intervention activities did not change much over time (i.e., only three different levels of learning). It is possible the app became less novel over time, making it increasingly difficult to interest the participants and maintain their attention. Likewise, the interventionists frequently used an occupational therapy room at the back of the classroom to deliver the intervention. This room included many toys that seemed to interest the participants more than the app at times. Similarly,

participants attempted to explore toys in the room during progress monitoring, which may have averted their attention from effectively identifying letters and numbers. For future studies using academic app-based interventions, the researchers recommend choosing a quiet space away from other toys and distractions to deliver the intervention. It may also be helpful for data collection and progress monitoring if the app itself collects progress monitoring data so that an interventionist does not have to switch from a fun, engaging activity to a less desirable activity. This may decrease inattention during progress monitoring and can help avoid distractions and behavior problems when changing tasks, as this is already an area that children with autism might have difficulties.

Another possibility is that the app was targeting another skill, such as teaching fine motor skills in drawing letters and numbers, rather than helping children learn new letters and numbers. The LetterSchool© app website professes that the app can help children learn letters and numbers as well as writing skills. While the app starts all teaching lessons with saying the letter and presenting it with an item that starts with that letter or counts to the number the child chose, this may not be enough to actively teach preschool children to identify letters and numbers.

The main portions of the app focus on connecting dots to write a letter or number. If this app is used again for research with preschool-age children, it is recommended that writing and motor skills are outcome variables rather than academic outcomes. Furthermore, this app was not specifically designed for children with disabilities. Children with AU and DD may have more attention difficulties when material is not novel (Yerys et al., 2009). When the interventionists were working with the participants, the children appeared to lose some interest in the app over time because the rewards and

noises were finite and repeated themselves after continued use. For adult consumers who are interested in app-based academic interventions for their children with disabilities, it is recommended that adults choose apps that have many ways that rewards are provided. It is also recommended that these apps include multiple activities instead of focusing on only a few similar activities (e.g., tapping, tracing, writing).

While this app-based academic intervention was not successful in teaching children with AU and DD letters and numbers, it is an important addition to the literature on app-based academic interventions for children with disabilities. Studies with null results importantly contribute to meta-analyses and reduce the likelihood of publication bias (Mervis, 2014; Rothstein et al., 2005; Sterling, 1959). Publication bias refers to the phenomenon that more significant findings are published in peer-reviewed journals, and studies with insignificant results may never be published or accessible to researchers conducting meta-analyses. This can lead to inflated effect sizes in meta-analyses, a finding in both the psychology and special education literature (Ferguson & Brannick, 2012; Gage et al., 2017). In fact, a special issue regarding SCD studies used in meta-analyses was published, finding that publication bias is an issue within meta-analytic reviews in school psychology and education (Shadish, 2014). Publishing nonsignificant results can help decrease the chance of publication bias in meta-analyses (McClain et al., in press). The current study adds to the literature on what works and does not work for children with AU and DD.

Limitations and Future Directions

There are several limitations to this study. One limitation is that the study only included five participants. This small sample is not generalizable to other children who

are in the AU or DD categories. The intervention was also conducted in a room with many distractions, leading to attention and behavior problems during the intervention and progress monitoring. Future studies that use app-based academic interventions should seek to use quiet spaces with minimal distractions. In addition, future studies could use a preference assessment of different academic apps so that children would be more likely to stay engaged with the app they chose. It is also possible that the children in the intervention were receiving other special education services. These services could have impacted their performance on number and letter identification tasks. While this study meets the What Works Clearinghouse (WWC) design standards for a multiple baseline design (Kratochwill et al., 2010), maintenance was not assessed as a third phase. This constraint was due to the school year ending and is a clear limitation to the design. Similarly, WWC (2010) has clear standards for generalizability, and more studies conducted at different sites with different researchers are needed to corroborate these findings. Additionally, 14 minutes of intervention per week is a very small amount of time to receive intervention. It is possible, and even likely with one outcome variable showing a trend towards significance, that we may have seen significant results if the children had more intervention time each week. The intervention also may have been more successful if each child received intervention 5-7 minutes per day or twice a day each day of the week so that the study was not so lengthy, and the children did not become as bored with the intervention over time.

Conclusion

Children in the AU and DD special education categories have many difficulties in academic areas that are often overlooked when intervention planning for these

students. App-based academic interventions are a viable tool for use in teaching children with AU early academic skills. While the LetterSchool© app was not effective in teaching preschool children letters and numbers, more research in exploring app-based academic interventions is needed to better understand their effects with children with disabilities.

Table 4

Scores on the Bracken School Readiness Assessment (BBCS-3:R) Before and After Intervention

		Pre-Intervention			Post-Intervention		
	Diagnosis	Raw Score	Composite Score	%	Raw Score	Composite Score	%
Christopher	AU	46	89	23	43	82	12
Gavin	DD	32	77	6	37	77	6
Ethan	AU	0	50	<0.1	4	55	0.1
York	DD	35	80	9	24	66	1
Shawn	DD	43	87	19	34	74	4

Note. AU = Autism special education eligibility; DD = Developmental Delay special education eligibility. Pre-intervention scores are normed for 4-year-olds, whereas post-intervention scores are normed for 5-year-olds as all participants turned five during the intervention.

Table 5

Parameter Estimates for Final Three-Level Generalized (Logistic) Multilevel Model (GLMM) for Correct Identification Regressed on Intervention by Phase and Presentation

Fixed Effects	*b (SE)*		*OR* [95% CI]		*Sig.*
Intercept	-0.80	(0.52)	0.45	[0.16; 1.25]	.120
Main Effects					
Intervention vs. Baseline Phase	0.23	(0.25)	1.26	[0.76; 2.08]	.367
Expressive vs. Receptive Presentation	-1.20	(0.16)	0.30	[0.22; 0.42]	<.001***
Condition (*reference = Uppercase*)					
Lowercase Letters	-0.10	(0.14)	0.90	[0.68; 1.20]	.472
Numbers	0.75	(0.14)	2.13	[1.62; 2.79]	<.001***
Interactions					
Intervention x Expressive	-0.30	(0.23)	0.74	[0.47; 1.17]	.193
Differential Time Trends	-0.01	(0.05)	0.99	[0.90; 1.09]	.794

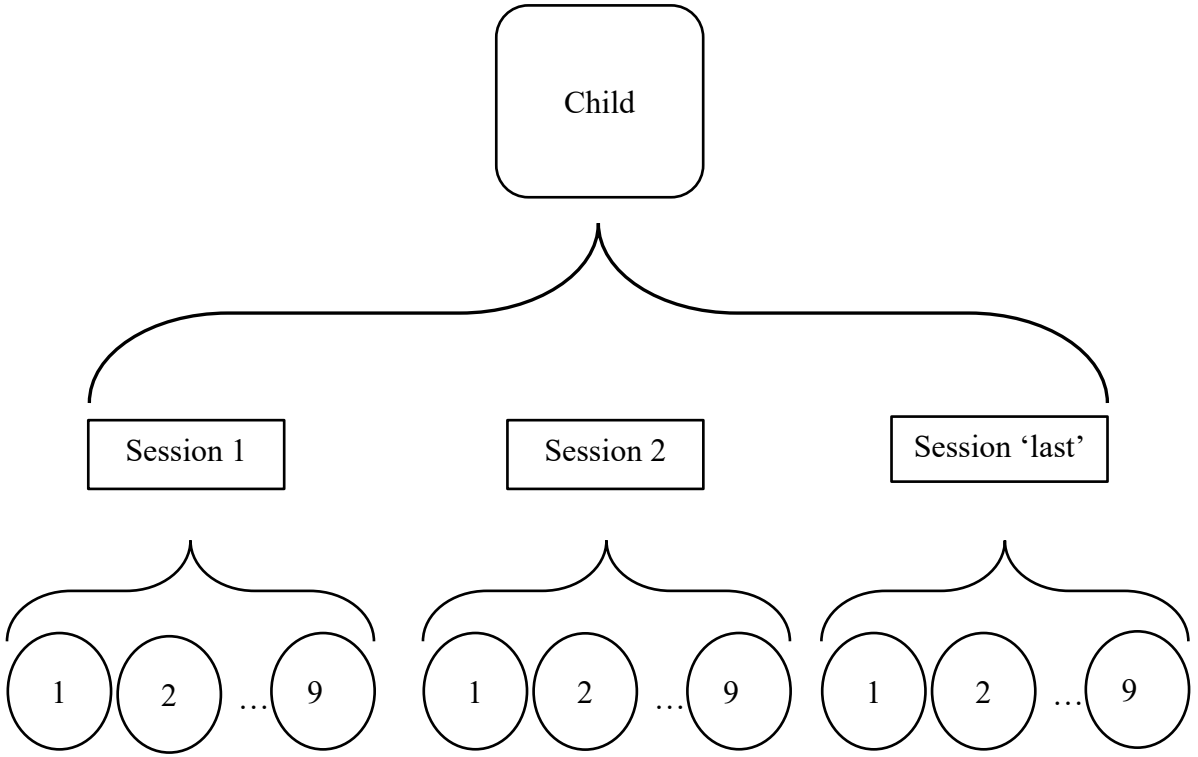
Random Effects	Var	SD
Participant	1.212	1.101
Session within Participant	0.139	0.373

Note: Significance denotes the p-value for Wald-like z-test for parameter estimates. Sample is comprised of 5 participants with a total of 65 sessions in which 390 responses were observed.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Figure 5

Structural Diagram of the Hierarchy of Experimental Observations by Session and Child



Level 3

Units = Participants
IV = Gender
IV = Age
IV = Diagnosis

Level 2

Units = Sessions
IV = Intervention (baseline/intervention)
IV = Day (….-2, -1, 0, 1, 2, …)

Level 1

Units = Responses
IV = Presentation (expressive, receptive)
IV = Condition (uppercase, lowercase, numbers)
DV = Accuracy (0/1)

Figure 6

Person Profile Plots from the Observed Performance across All Domains and Children

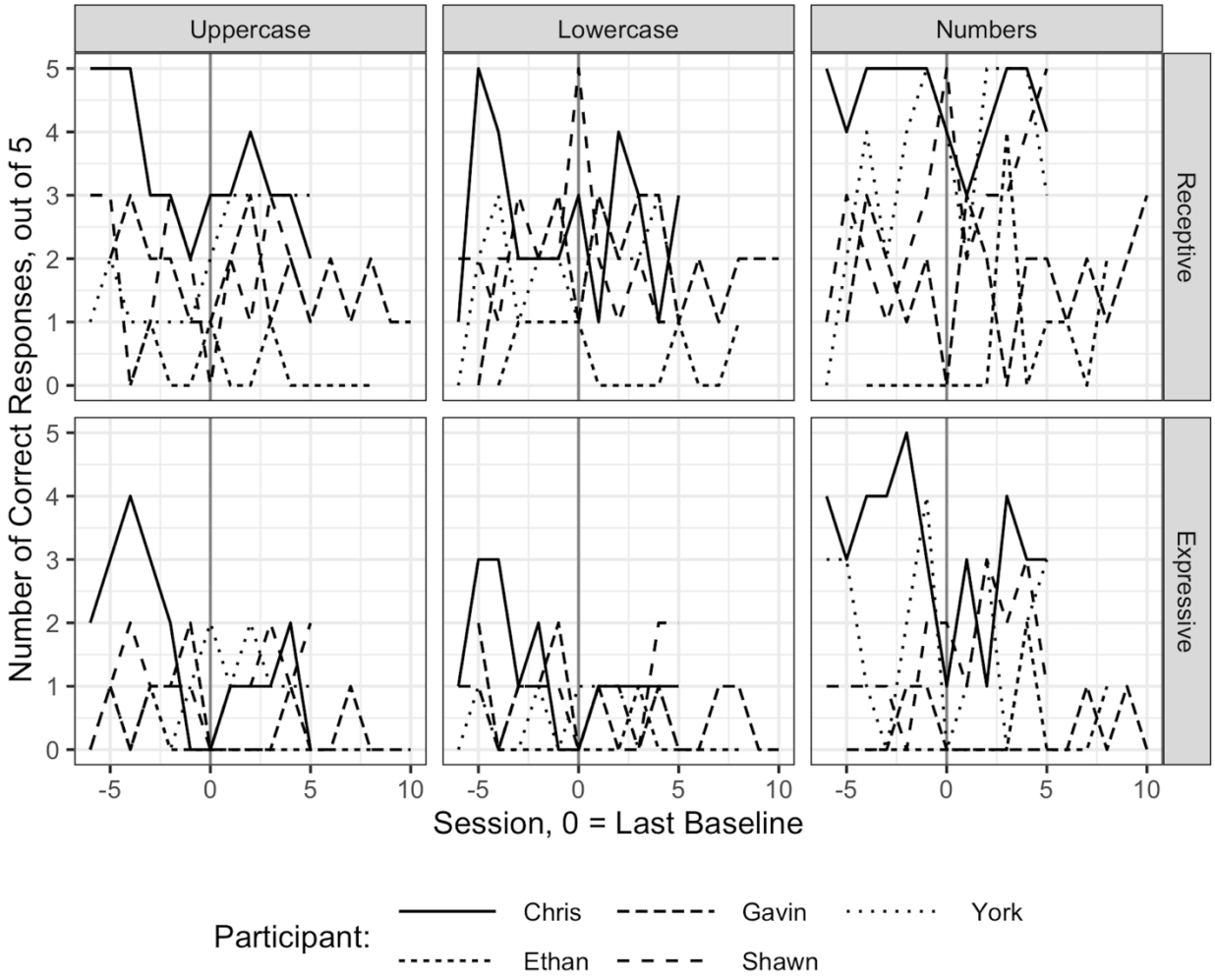


Figure 7

Number Correct on Uppercase Letters

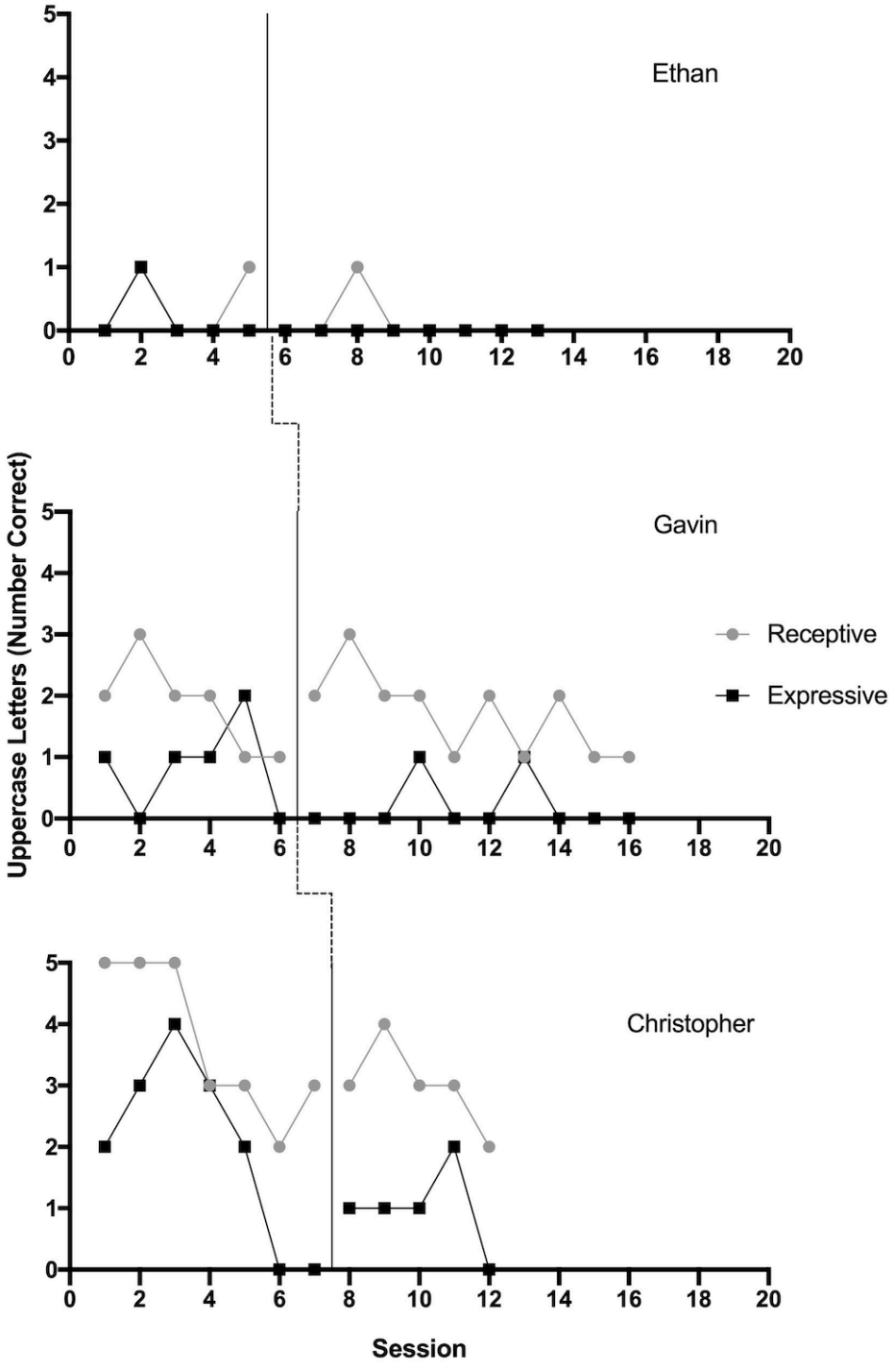


Figure 8

Number Correct on Uppercase Letters

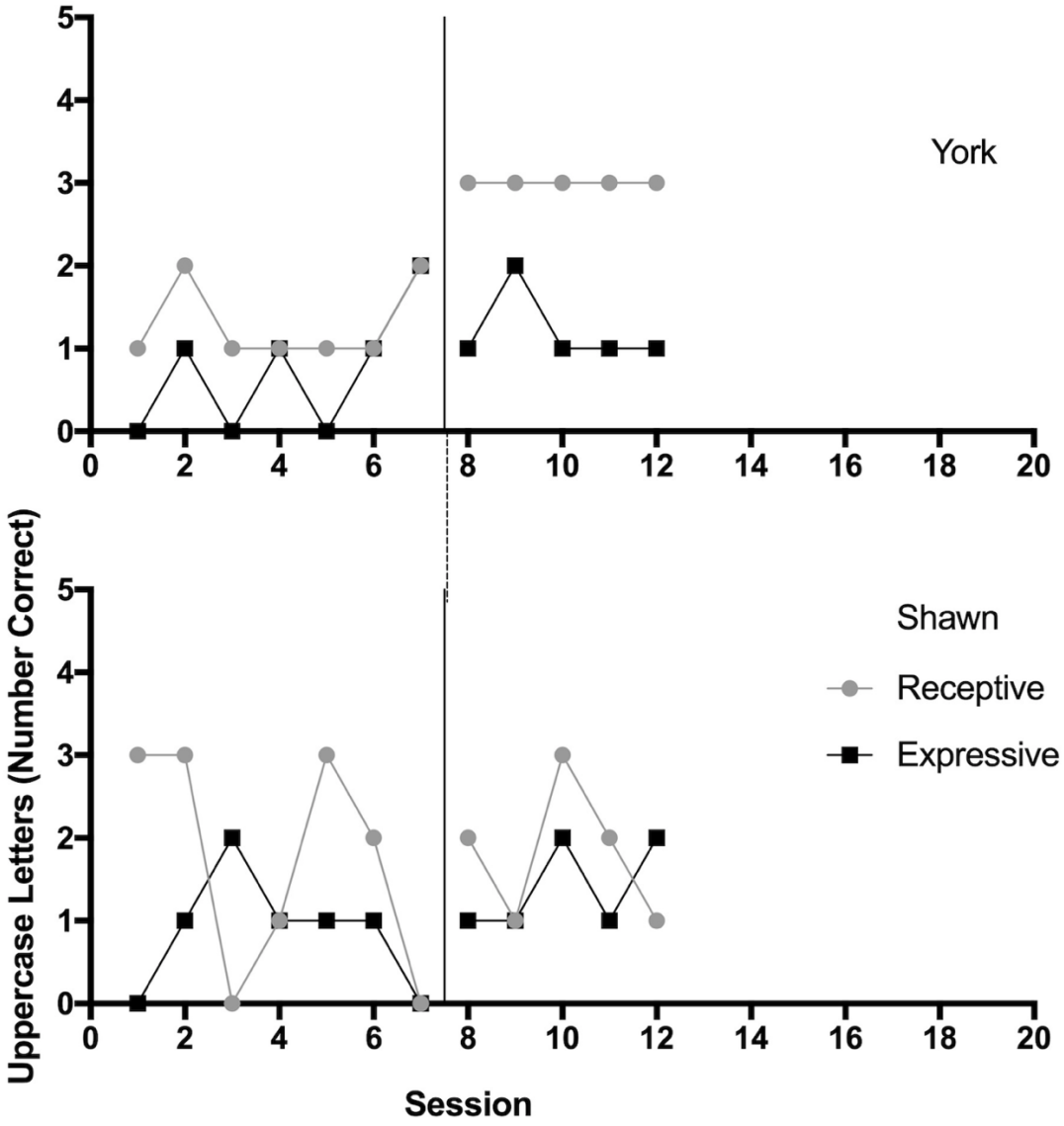


Figure 9

Number Correct on Lowercase Letters

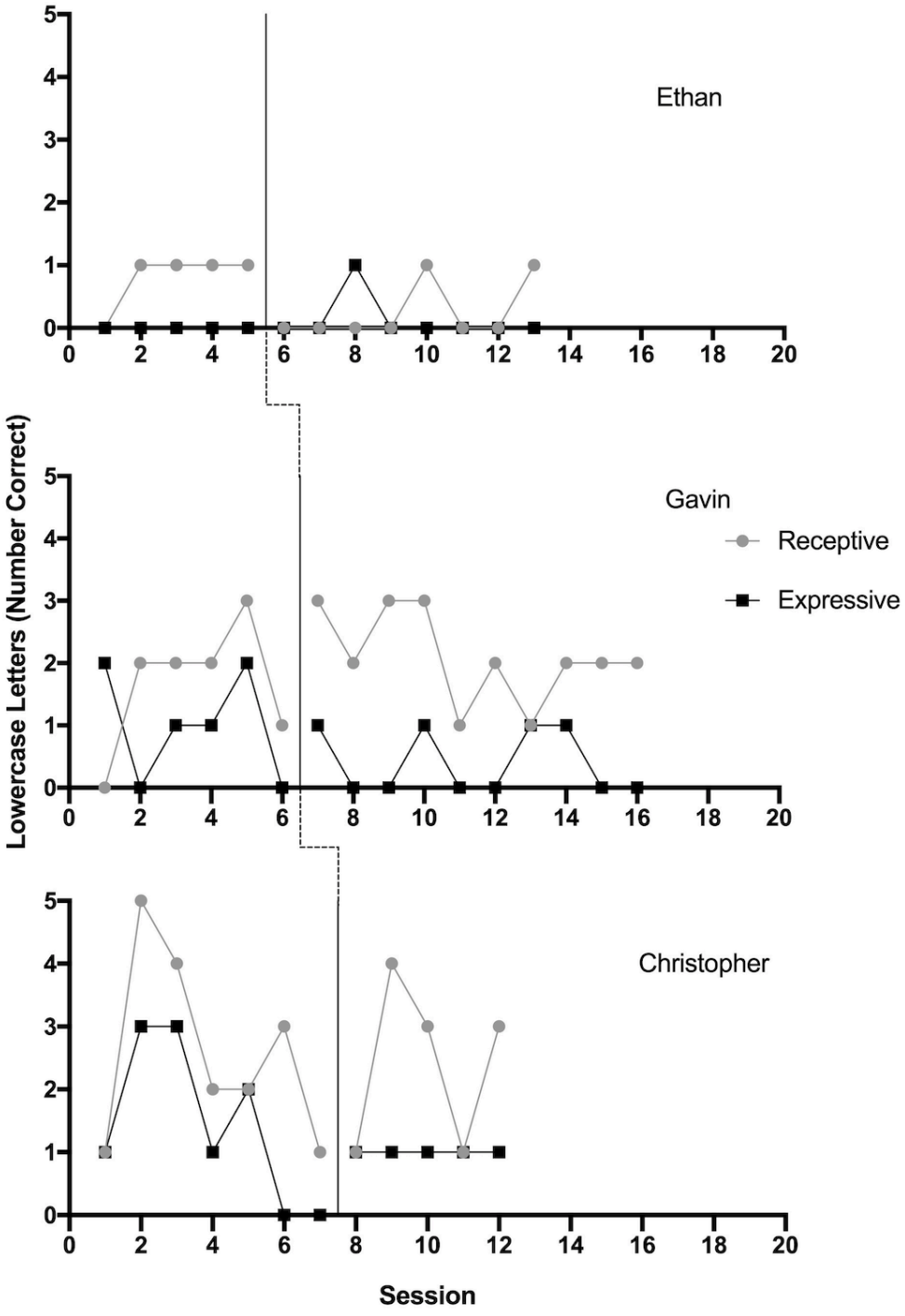


Figure 10

Number Correct on Lowercase Letters

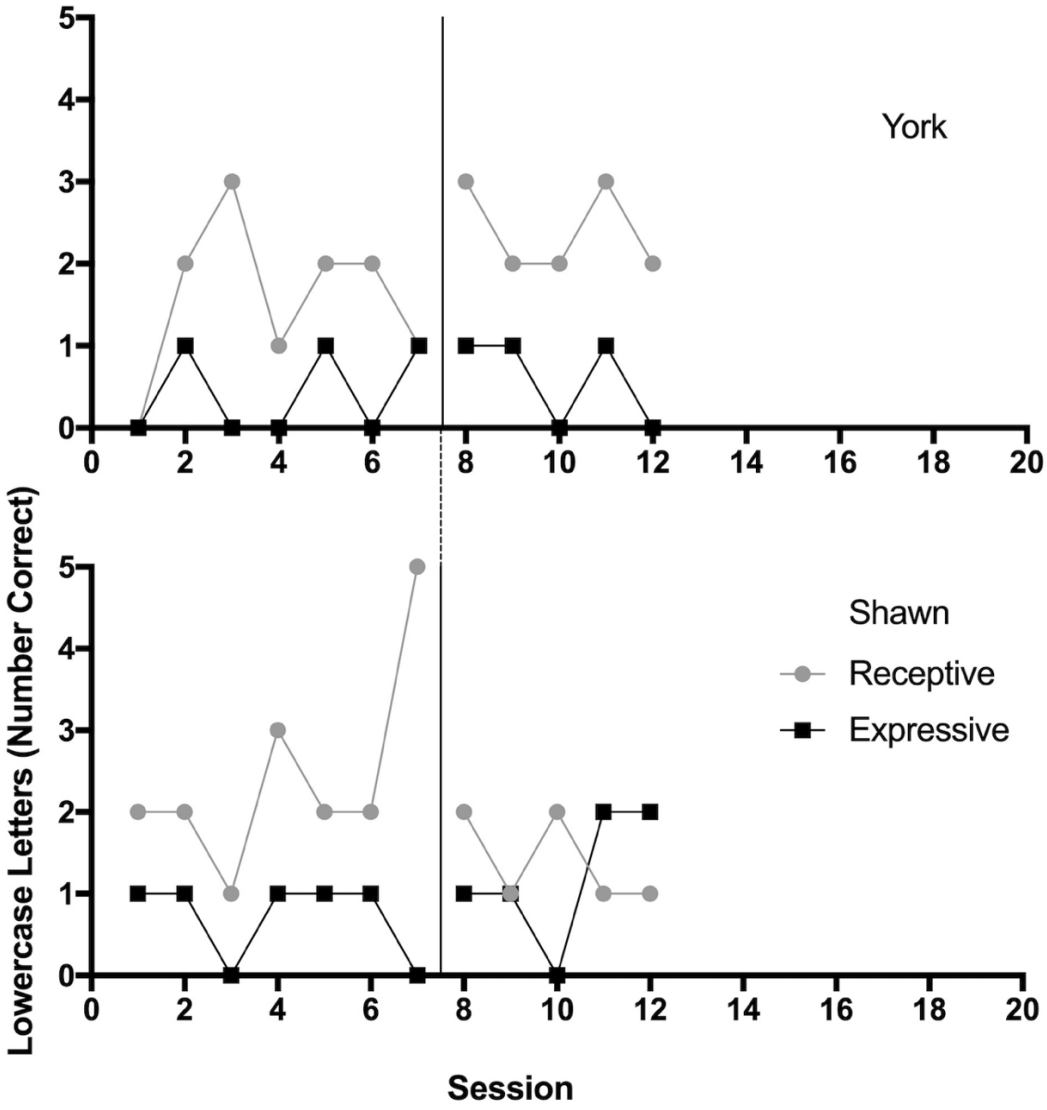


Figure 11

Number Correct on Numbers

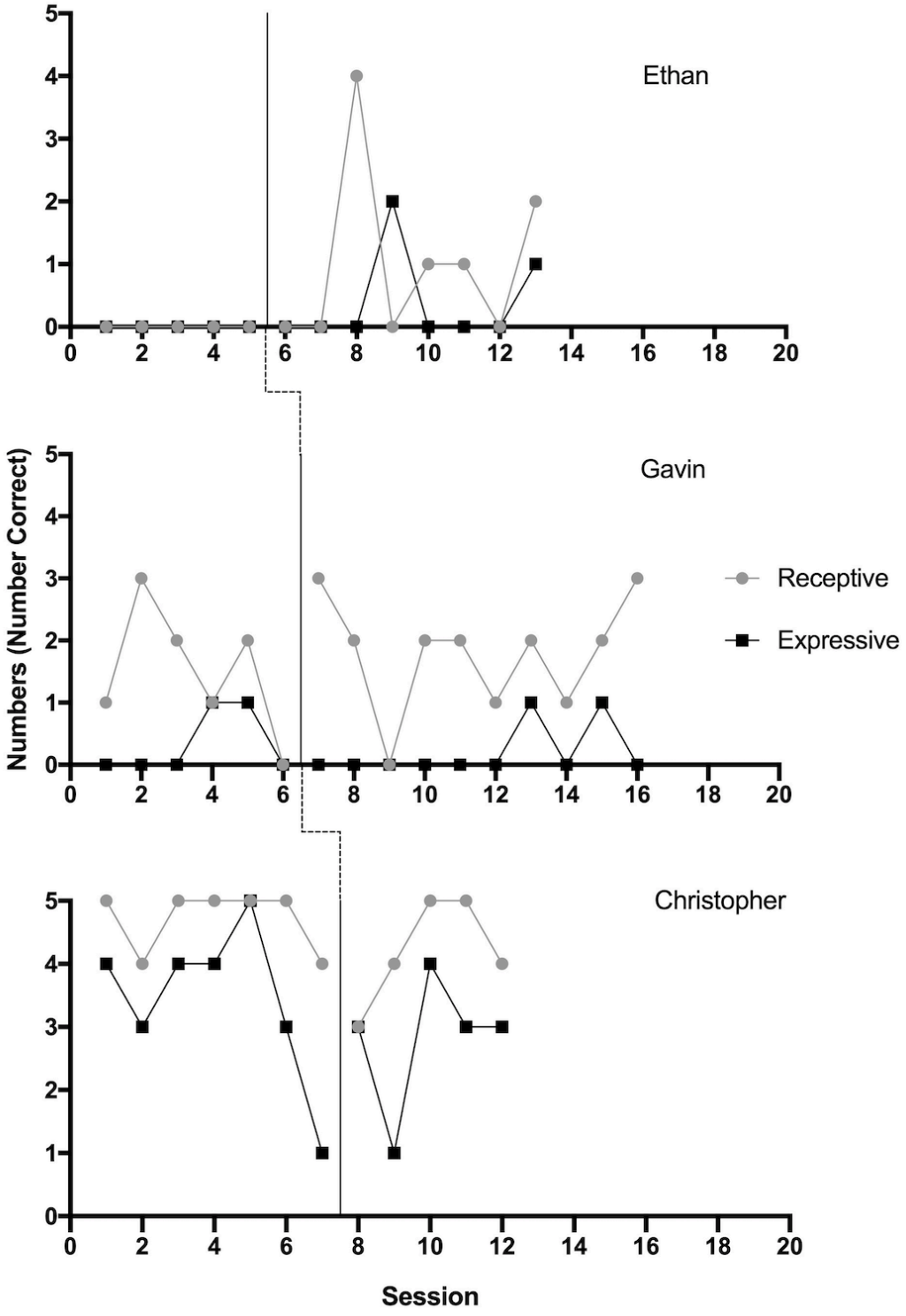


Figure 12

Number Correct on Numbers

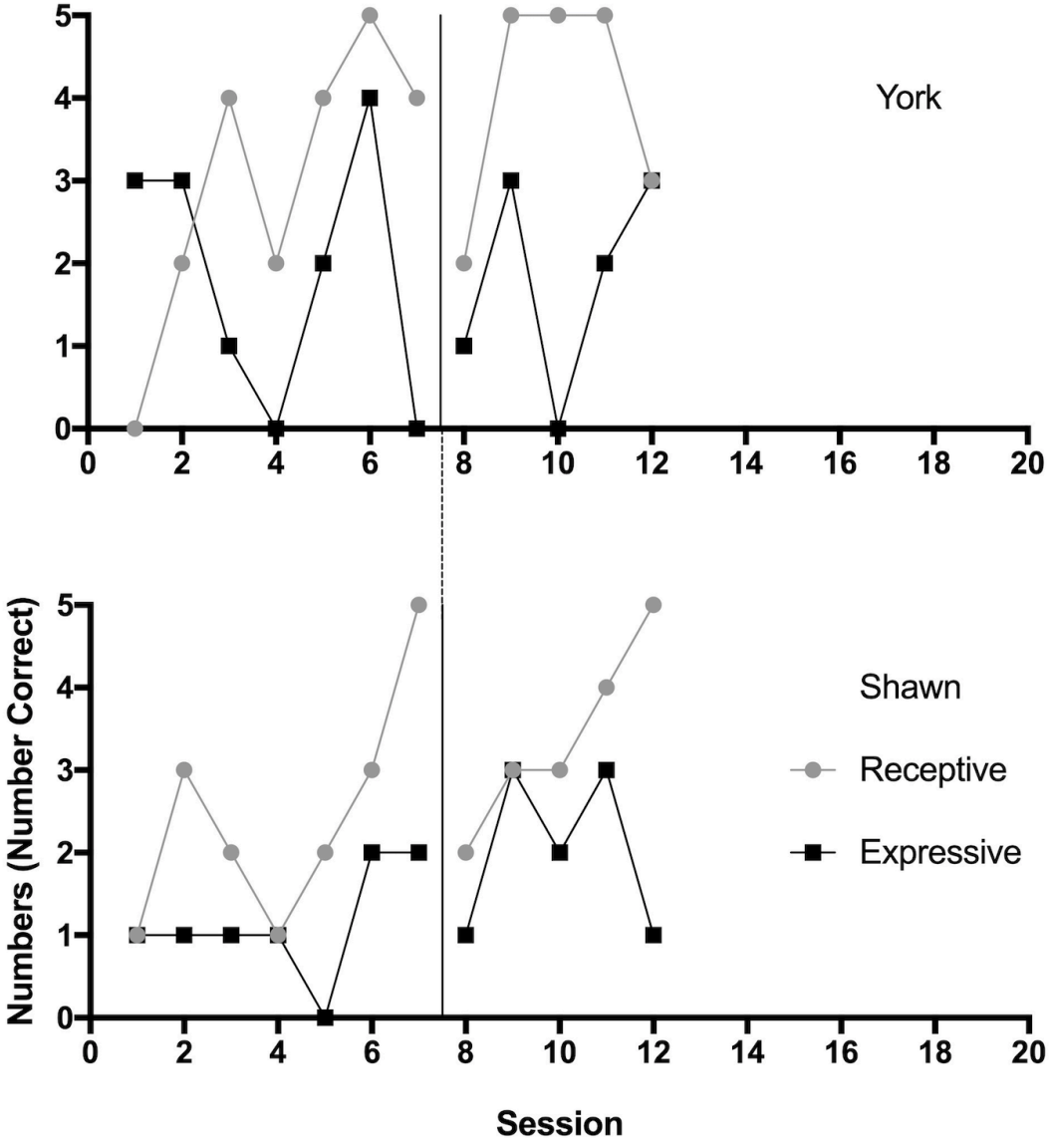
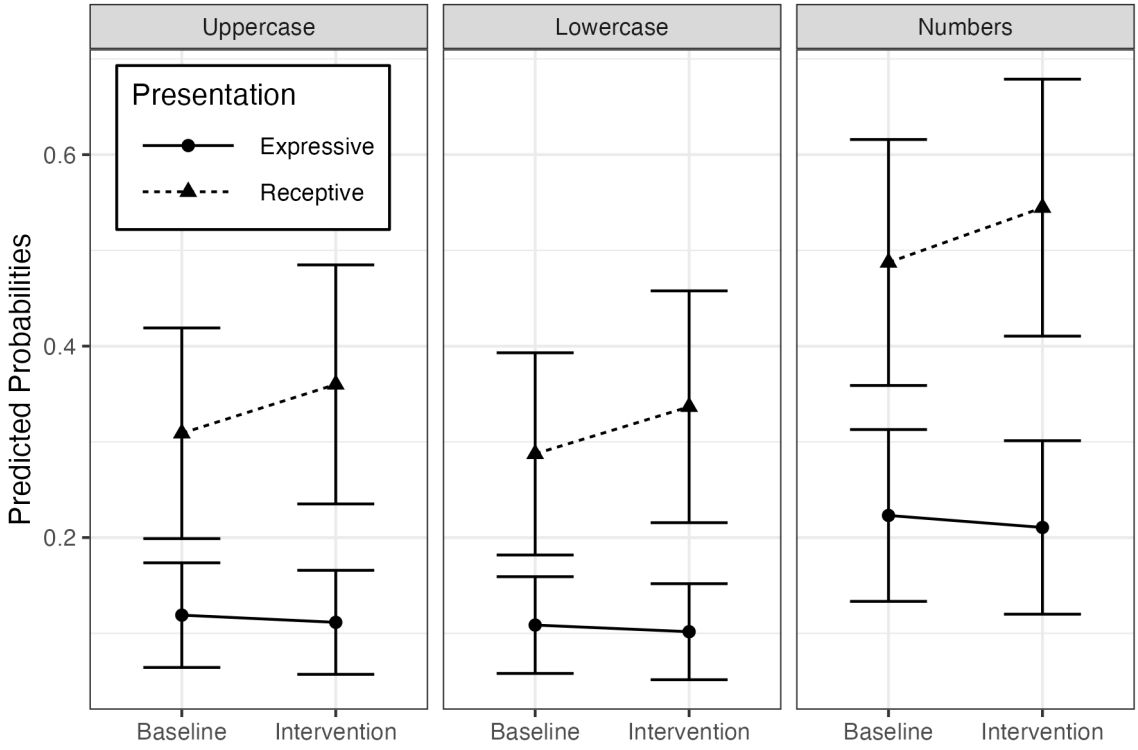


Figure 13

Predicted Probability of Accuracy from the Final Logistic GLMM Analysis



Note. Confidence bands represent 95% confidence intervals for the predicted probabilities.

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CHAPTER IV

PARENTS' PERCEPTIONS AND USE OF APP-BASED ACADEMIC INTERVENTIONS WITH THEIR CHILDREN WITH AUTISM: A QUALITATIVE PERSPECTIVE

Introduction

While many interventions for autistic children within schools are focused on improving social skills (Dean & Chang, 2021), children with autism are also likely to have challenges in academics (Keen et al., 2016; Wei et al., 2014), such as reading comprehension and math problem-solving (Aagten-Murphy et al., 2015; Mayes & Calhoun, 2008; McIntyre et al., 2017; Nation et al., 2006; Shin et al., 2013; Whitby & Mancil, 2009). Difficulties with executive functioning, especially inattention, can further compound academic problems. Children with autism may have difficulty attending to pertinent material in reading passages and multi-step math problems (May et al., 2015; Whitby & Mancil, 2009). Likewise, they may have challenges with theory of mind when answering reading comprehension questions or solving math story problems (Tong et al., 2020; Whalon & Cox, 2020).

To aid children with autism who experience academic challenges, many have turned to technology. Specifically, app-based technology has been popular among education professionals and parents to teach academic skills. App-based learning may be enjoyable for children with autism because it is often very engaging, and it requires less direct interaction with other people (Baron-Cohen, 2006; Neelyet al., 2013). In a study observing children with autism using tablet applications in an education setting, children with autism independently used app-based learning for 53% of the time they used a

tablet, and children used academic apps for 51% of the time on the tablet (King et al., 2014). Students were also more likely to use the apps as intended if an education professional was present in the room and if the app was academic-focused or a game (King et al., 2014). This shows that academic apps can be just as engaging as games for children with autism.

App-based interventions such as *iCommunicate* (Ganz et al., 2014) and *SMART notebook* (Browder et al., 2017; Root & Browder, 2019) have proven to be effective methods of teaching language and reading comprehension skills to students with autism. Similarly, the *SMART notebook* (Browder et al., 2017; Root & Browder, 2019) has helped children with autism learn multi-step math skills. Other studies have examined using app technology to teach a variety of academic skills to children with autism (Smith et al., 2013). App-based academic interventions often have elements that keep children engaged (e.g., changing the screen often, requiring touch elements) and incorporate built-in goals and rewards. For education professionals and parents, it is also important that app-based interventions have some form of internal data collection built into an app that adults can track over time to see a child's progress and mastery of academic skills (Ennis-Cole & Parkman, 2012).

Professional Perspectives on Technology

Some professionals choose to use app-based and other digital technologies for psychoeducation and intervention with children with autism, although the use of these tools in clinical settings remains somewhat rare (Clark et al., 2015). Possible reasons why app-based and digital technologies may be chosen over other methods are their portability (e.g., easy for professionals to carry from appointment to appointment), multiple uses

(e.g., professionals can provide the same intervention or psychoeducation videos to several clients), affordability (e.g., many apps cost less than two dollars), and they are tools that are engaging for young clients (e.g., children with autism may find tablets highly engaging ; Ferrari & Suzanne, 2017). Clinical and school psychologists, applied behavior analysis (ABA) specialists, speech-language pathologists (SLPs), teachers, and primary care providers could all use technology-based interventions to help children with autism learn new skills, including academic skills. However, little research has shown how professionals view the use of academic apps, although researchers have explored other areas of app-based intervention.

Ferrari and Suzanne (2017) examined physicians' perspectives on a psychoeducational video game used in primary care settings. Physicians found the video game useful for introducing the topic of mental health to pediatric patients, saving time, and addressing pediatric questions about specialized topics (Ferrari & Suzanne, 2017). Special education teachers and teaching assistants indicated that children with disabilities in their classrooms most frequently used tablets in school for learning literacy and math skills (Johnson, 2013). Children with disabilities most often used tablets to learn fine motor skills in printing, letter recognition, and number recognition. These teachers also endorsed using tablets in the classroom because they were engaging, helped children attend to academic stimuli, and many apps were customizable to each student's needs (Johnson, 2013). Specific to autism, SLPs also found augmentative and alternative communication apps useful in practice (Boster & McCarthy, 2018). Specifically, SLPs viewed features such as customizable animation, a message window oriented from left to right to improve literacy, colored communication categories, and a grid format as

beneficial for children with autism (Boster & McCarthy, 2018). Overall, professionals who work with children with autism and other disabilities tend to have a positive attitude toward using technology and app-based interventions (Clark et al., 2015). However, many professionals do not use tablets or minimally use them in their practice, suggesting that professionals who work with individuals with autism may need more training in how to effectively use tablets and app-based interventions in their practice (Clark et al., 2015).

Parent and Family Perspectives on Technology

While professionals have a strong buy-in to technology use with individuals with disabilities, parents and caretakers of children with autism are even more likely to use tablets for intervention in the home setting (Clark et al., 2015). However, parents and caregivers may take a trial-and-error method to determine which technologies and apps are best suited for their child (Christon et al., 2010; Ennis-Cole & Parkman, 2012). Studies examining parent perspectives provide insight into how researchers can create technological interventions and activities that will be useful to children with autism in the home setting. These studies can also help determine what is working or not working for children with autism and their families when it comes to technology interventions.

Parents and caregivers might choose to use apps with their children for a variety of reasons. Frequently, these tools are used as an activity to engage children while parents complete another task, during waiting times, or as a scheduled entertainment activity or reward (Sergi et al., 2017). Children with autism tend to learn to use technology tools when they are young (i.e., 1-2 years old) and typically use them for 30 minutes to 2 hours per day most days of the week (Clark et al., 2015; Finke et al., 2015; Sergi et al., 2017). Based on the current literature, parents of children with autism typically support the use

of technology with their children, stating that it can develop crucial skills including social, motor, and academic skills (Finke et al., 2015; Sergi et al., 2017). When examining parental aspirations for their children with autism, social and academic skills are highly valued as children transition to adulthood (Camarena & Sarigiani, 2009). Using tablets for entertainment purposes is common, but parents also choose to use educational apps for their children on portable digital devices, including early math and literacy apps (Ennis-Cole & Parkman, 2012; Sergi et al., 2017). For instance, parents of children with autism indicated that brightly colored animations, message windows that support literacy, and a grid format could all be incorporated into communication apps to support children with autism (Boster & McCarthy, 2018).

Parents may also have significant concerns when it comes to technologies and tablet applications. For instance, parents noted that letting their children use tablets might lead to screen addiction, fewer social interactions, and less physical activity (Sergi et al., 2017). Parents of children with autism were also concerned that parts of apps (e.g., shapes, sparkles) might be distracting from learning materials (Boster & McCarthy, 2018). Parents may also have difficulty choosing apps that work from the multitude of choices available in app stores for the many areas in which children with autism may need support (e.g., social, motor, academics; Ennis-Cole & Parkman, 2012). Parents may also find it difficult to choose technologies and apps that work based on the limited evidence base in the research literature (Lubniewski et al., 2018; Robinson & Bond, 2017).

The Current Study

Overall, parents of children with autism tend to believe that technology and app-based interventions can help improve their children's skills (Finke et al., 2015; Sergi et al., 2017), but it is unknown which apps parents find most useful and effective for their children with autism. Likewise, little is known about parents' positive or negative views and perceptions of specific types of apps, including academic apps for children with autism, rather than technologies in general. By understanding parents' perceptions of academic apps, professionals can ascertain the needs of children with autism and their families. Through understanding parents' views, professionals can also collaborate with parents more effectively and help them find academic apps that are evidence-based for children with autism. This may also help keep services continuous across clinic, school, and home settings. Because there is a dearth of research in this area, a qualitative approach using a phenomenological methodology will help professionals who work with children with autism to better understand parents' experiences with academic apps used by children with autism. To address this gap in the literature the current study aims to answer the following questions: (1) What are primary caretakers' (e.g., parents, grandparents) perceptions, including possible benefits of and barriers to, using academic applications for children with autism in the home setting?, (2) What are current academic applications that children with autism use in the home setting, and what features make these applications best suited for children with autism?, and (3) How can primary caretakers and professionals work together to find effective academic apps that can be used in the home setting?

Method

Procedures

After institutional IRB approval, the researcher recruited individuals who had experienced the phenomenon (i.e., have an autistic child). The researcher called participants from prior research studies who indicated they could be contacted for future studies. The researcher also created a recruitment flyer that was placed in community locations (e.g., library, university, clinics). The researcher sent the flyer out to schools, clinics, and researchers who work with children with autism and their families. These organizations and individuals sent the flyer out to listservs of possible participants. The researcher also posted the flyer on social media websites (e.g., Twitter). The researcher made three attempts at recruitment through these means, with seven parents/caretakers indicating initial interest in participating. After receiving a copy of the informed consent document, only three participants decided to go forward with a phone call and brief interview to determine study eligibility.

All three participants met the study inclusion requirements. Participants were primary caregivers of autistic children aged 3-12 years. The definition of a "primary caregiver" was any adult person who was primarily and legally responsible for the care of a child, including parents, grandparents, aunts/uncles, or other close family members with legal custody of a child. Participants were caregivers of children who had a medical diagnosis of autism or who were classified under the Autism special education eligibility category. Caregivers of autistic children who were not primary caregivers or caregivers who had children with autism over the age of 12 were not included in the sample. All participants lived in a state in the Mountain West region of the United States. Participants

were adults over age 18 years. Caregivers under 18 years were not included in the sample. Participants also were required to functionally communicate in English, as qualitative interviews were conducted in English. This was decided due to the qualitative nature of the study. It was determined that important content and meaning could be lost if translated into English from another language.

Participants signed informed consent documentation and a brief demographic form via Qualtrics (Qualtrics, 2023) before participating in the full interview. Interviews were conducted by an IRB-approved researcher. Due to the COVID-19 pandemic, the researchers conducted individual interviews using teleconference technology (e.g., Zoom). Families were asked to find a quiet space in their home to participate in the interview, as all sessions were audio and video recorded. Interviews lasted from 20 to 60 minutes. The researcher used a semi-structured interview to gather information from participants. Each participant answered all qualitative questions found in Appendix D. Audio and video were stored in a secured online Box.com folder. The researcher also conducted behavioral observations (e.g., facial expressions, reactions to questions) during the interview that helped to inform the context for participant responses.

Participants

Participants included three parents of children with autism. The first parent, Abigail (all names included are pseudonyms), was a 35-year-old White female with a 5-year-old boy with a medical diagnosis of autism. He also received special education services under the Developmental Delay category. The second parent, Brianna, was a 34-year-old White female with a 3-year-old boy with a medical diagnosis of autism. He also received special education services under the Developmental Delay category. The third

parent, Claire, was a 37-year-old White female with a 5-year-old boy with a medical diagnosis of autism. He did not receive special education services. All participants lived in a Western state in the United States.

Qualitative Approach

The current study used a phenomenological approach with elements of case study to answer the research questions. The researcher both explored a shared experience among a group of people (Creswell & Poth, 2018) and focused on each individual parent's experience. Within the fields of psychology and education, phenomenology is a common qualitative approach to better understanding a phenomenon (Creswell & Poth, 2018; Emery & Anderman, 2020; Englander, 2016). Past research exploring similar topics (e.g., parents' perspectives of apps, teachers' perspectives on tablets in education) included qualitative and mix-method approaches to the issue, supporting a predominantly phenomenological approach. The current study aims to understand the shared experience of parents with a child with autism. Specifically, the researcher aimed to understand caregivers' use of academic apps with their children. The researcher also discovered that each case included elements specific to each child, so parts of case study methodology were included.

Data Analysis

Audio recorded data collected during interviews were sent to a transcription service within the NVivo (QSR International Pty Ltd., 2020) qualitative software providers. All transcribed documents were kept in a folder on Box.com. The researchers used qualitative software NVivo as the main method to analyze the data. Five researchers in total examined the data as a coding team. First, the researchers read the transcriptions

several times to become familiar with the data. The researchers used the qualitative software to pull potential themes from the data, as its software can find similar word patterns and group similar words. The team created word use charts and visual clouds to aid them in looking for potential codes and themes. The software also provided some guidance by looking at similar sets of words. In some ways, these automated tools were helpful to start, but ultimately, familiarity with the data was more helpful when interpreting the transcripts. The research team proposed themes that they believed helped to answer the research questions in conjunction with the initial text data gathered from the software. Next, the researchers used the qualitative software to inform and revise their themes with smaller codes from the text that fell under each theme. The researchers then created a final coding scheme of broad themes and codes. The five coders had disagreements at times. Instead of double-coding the data, the researchers discussed amongst themselves when disagreements arose. Because they had an odd number of researchers, there was a tiebreaker if the group could not come to an agreement. The coders discussed codes and themes until they reached 100% agreement. Then they had an outside researcher on the team examine the codes and themes for clarity. The researchers triangulated data through transcriptions, recording behavior observations, and having a researcher outside the coding team review the codes and themes. Throughout the data analytic and writing process, the researchers referenced the American Psychological Association (APA) journal article reporting standards (JARS) for qualitative research design (Levitt, 2018).

Positionality Statement

Our subjective lens in this study was focused on gathering pragmatic and useful information. However, because everyone who examined the data and worked on interpretation brought their own lens to the table, it is important to recognize our group's potential biases entering into qualitative research. No researcher on this team shared the experience of the participants, as no one was a parent or had an autistic child. We also recognized that we approached this work as educated White, Asian, Latina, and Biracial women studying autism from a clinical and research perspective. While we shared some characteristics with the participants, we understood that our positionality influenced our coding and interpretation of the data to some extent. We hoped that by having multiple individuals viewing and analyzing the data, we could check each other's biases, recognizing that our results would be affected by our own experiences.

Results

Though each participant is experiencing the same phenomenon of having a young child with autism who uses academic apps, the interviews brought to light unique situations and experiences This section reviews each participant's unique experience of raising an autistic child and then examines codes and themes found across individuals.

Abigail's Case

Abigail was a 35-year-old mother of a child with autism. She indicated that she was married, and her annual household income was greater than $100,000. Her son was 5 years old and attended kindergarten with special education support under the Developmental Delay category. He did not have any co-occurring disabilities. She

reported that her son used his portable digital device 4-5 hours per week and regularly used an academic app.

Abigail's son was nonverbal and used Proloquo2Go © (AssistiveWare B.V., 2023), to help him communicate at home and school. While this is primarily a communication-focused app, she reported that he almost always used it at school to complete academic tasks, including learning numbers, shapes, and words. Abigail frequently talked about her child's communication using the app or switching to sign language when the app could not communicate what he wanted to say. Communication as a code rarely came up with the other participants. Regarding the app and her son's ability to communicate using it, she stated, "He can tell us what he needs or wants." She also reported that "It helps him at school."

Based on behavior observations during the interview, Abigail was engaged with the interviewer throughout with open posture and direct answers. She primarily had positive perspectives about the academic app her child used. She often focused on the app's usefulness and her child's positive and challenging behaviors regarding the app. Abigail also generally appeared stressed during the interview, and she seemed to enjoy talking with someone about the challenges she experiences related to her child's autism and developmental delays, whether it be the lack of age and developmentally appropriate toys available to her son or the difficulties of using a communication app while driving in the car.

Brianna's Case

Brianna was a 34-year-old mother of a child with autism. She reported that she was married, and her annual household was between $50,000 and $74,999 per year. She

reported that she had earned a bachelor's degree. She had two sons with autism. Her youngest son was 3 years old and attended a special education preschool under the Developmental Delay category. She added that he did not have any co-occurring disabilities. She reported that her youngest son used his portable digital device for 2-3 hours per week and regularly used academic apps. During the interview, she also noted that she had an older son who was 6 years old. We only collected descriptive information on Brianna's younger child, but she provided qualitative information about both of her children.

Brianna's case was unique because her children used a variety of academic apps. She reported that her younger son had more academic-related challenges with problem-solving, spatial reasoning, and motor skills, while her older son struggled with reading. She actively searched for new apps that could aid them with their academic and social skills challenges. In total, Brianna discussed 21 apps during her interview, and 15 of those were specifically academic focused.

Based on behavior observations during the interview, Brianna was very engaged with the interviewer and often chatted freely, sometimes straying from the topic. She stated that she was anxious about the interview. She often talked quickly, which may have been a manifestation of her anxiety. She typically had positive things to say about academic apps with a few downsides. She focused on how academic apps specifically met the needs of each of her children.

Claire's Case

Claire was a 37-year-old mother of a child with autism. She reported that she was married, and her household annual income was greater than $100,000. She indicated that

she had earned a bachelor's degree. She reported that she had two children with autism, a 10-year-old son and a 5-year-old son. She primarily discussed her younger son because he used an academic app regularly. Her 5-year-old son attended kindergarten, but he did not receive special education support. She reported that he did not have any co-occurring disabilities. She indicated that her younger son used his portable digital device for 1 hour or less per week and regularly used an academic app.

Claire reported that her younger son primarily used an academic app for school purposes, though he did not have any specific challenges with academic material. This was unique as the other participants' children struggled with at least one academic domain. Claire's younger son used Lexia © (Lexia Learning Systems LLC, 2023), which was an app that his school had required for use with all families in his classroom. Claire reported that the app was good for differential instruction with students. However, when her son took an academic pretest on the app at the beginning of the school year, she felt as if her son did not perform well. Based on his score on the app's academic pretest, the app placed him at a certain level in the app where he could start working on academic tasks. Claire stated that because the app placed him at a lower level, he was completing academic work on the app that he already knew. For instance, she stated, "Sometimes he doesn't tell the app everything he knows. And so, then he may not progress, and he keeps on doing the same thing over and over again."

Based on behavior observations during the interview, Claire was engaged with the interviewer. Claire used more formal language, was concise with her answers, and took time to think about her responses. She often smiled and used gestures when talking with the interviewer. Her reactions to academic apps were a mixture of optimism and caution

about relying too heavily on technology. She often focused on her child's engagement with apps, including his challenges with attending to relevant material in apps.

Broad Themes and Codes

Phenomenological qualitative analysis resulted in five themes from 227 codes: (1) App Perspectives and Features, (2) Emotional Response to Apps, (3) Accessibility, (4) Resources Used in Conjunction with Apps, and (5) Future Development Ideas. A count based on the number of times participants discussed specific apps resulted in 57 further codes of the app names. Frequencies for codes/subcodes and themes are presented in Table 6.

App Perspectives and Features

The App Perspectives and Features theme represents how participants discussed the pros, cons, academic features, and non-academic features of specific academic apps. Participants frequently discussed how user-friendly academic apps can be and that they choose apps based on how easy they are to use. One parent stated that apps are "more user-friendly for him" and "that's [apps are] easy for him because he can see the pictures and something he recognizes already." Likewise, another parent noted, "He doesn't have to try and problem solve to the point where he's trying to find this little arrow or dot on the screen. He can just do it right there and learn how to do it." Similarly, they stated that academic apps can teach a concept quickly, and if the child gets the concept, they can keep moving on to other things in the app. One parent stated, "I think it gives them more practice in a shorter amount of time…so if you're doing it on technology, you can go as fast as you want to and still learn." They also noted that apps often provide repetition in academic areas that is useful for their children with autism. For instance, one parent said,

"I think it gives repeated practice, which is good," and another echoed, "I think the ability to do and repeat the same thing is helpful." Likewise, things such as portability, the number of customized options, and how technology can work well for children with autism were all mentioned. One mother stated, "It's better than lugging around all these flashcards." Another noted, "If I pull up something on YouTube to show them what it actually looks like, they're going to remember it 10 times better than if I just open up a book and show it to them."

Parents also noted several cons related to academic apps. For instance, parents noted that apps do not always match their child's age or ability level. One parent stated, "I think another kind of annoying aspect of it is the simplicity of some of them for the age range, and that again is more subjective because my 6-year-old is doing math and science at a 10-year-old level. So if I get him an app that's geared towards 6-year-olds, he's not going to be interested in it if it's for math and science. And so…he gets bored way too fast." Another said, "The thing that maybe is the drawback is that I don't think he really is necessarily at the place where it [the app] is challenging him. It started him at a certain place, I think they did some sort of a pre-test, and I don't know if he didn't really show what he knew. So, what he's doing in it is often a lot of review that he already knows." Likewise, parents recognized that apps often seem robotic and cannot replace human interaction. One parent said, "It [the app] still sounds like a robot." Another noted, "You're not getting that human engagement or interaction. Really, it is with a computer-animated voice, and it is with a screen where you're missing out on some of those social skills and even just listening because you just push it and it repeats over and over, whereas you're not really learning the skills of listening." Participants also noted that

apps can sometimes repeat content, activities, and tasks too much, or their children only find the answer by the process of elimination rather than learning the material.

Finally, participants discussed the different features within apps, whether academic or non-academic. Academic features included simple domains such as learning numbers, shapes, colors, letters, math, reading, science, and matching. They also included broader domains such as problem-solving and spatial reasoning. One app that a parent discussed also included an academic pre-test option. Non-academic features encompassed a variety of useful features, such as customizable buttons, pictures, and voices. They also included an easy-to-use grid system, a digital folder system, a colorful background, child-friendly graphics, and a restart button. Parents noted that additional games, ways to practice motor skills, and sections that taught emotions were also useful.

Emotional Response to Apps

Parents reported both emotional responses in themselves when providing their children with academic apps and discussed how their children engage with academic apps. Parents described their children's engagement with academic apps in a variety of ways. Sometimes they reported that their children enjoyed, liked, and had fun with academic apps. Parents noted that sometimes academic apps grabbed their children's attention, and their children even preferred academic apps to other apps. One parent said, "He chooses those academic options instead of more of the games and stuff that I would assume other children would pick." Participants also noted that their children felt motivated, rewarded, and praised when using academic apps. One participant noted, "And I think he enjoys too, like the graphics and some of that sort of stuff, and he pays a lot of attention to that and that's motivating for him."

Alternatively, parents reported that some apps had the opposite effect. For instance, they stated that their children could become easily disinterested, distracted, and bored with some academic apps if they were too repetitive, slow-moving, and not challenging. Participants stated, “So he’ll sit there and try and get it to the go, and that’s frustrating for him,” and, “So I think that the simplicity of the 6-year-old ones, he gets bored way too fast.” Participants noted that academic apps could also become frustrating, and their children would give up easily when they did not know the correct answer. One mother said, “When he gets stuck, he will get so frustrated unless he can start over.” Likewise, one parent added that apps and technology could become somewhat addictive for children. Participants also indicated that academic apps could be overwhelming for their children with autism because of bright colors and busy patterns. One mother stated, “If the background is super crazy and colors, then my one kid isn’t going to learn very well from it because he’s going to get overwhelmed and he’s never going to touch that app again. And so, I have to be very careful with that.”

Caregivers also noted their concerns about having their children use academic apps. One mother recounted when a professional first suggested that her child use an academic app, “One was talking to us about the app to get, and we’re like, we don’t think it’s a good idea…. We thought long because we were hesitant with the app.” Another mother described her process of choosing academic apps, “I definitely read the reviews. I usually hear about it from somebody else. Although when I find a creator that I like or a developer that I like, I tend to just go through there, and I read through the reviews, and I look at the preview of the pictures. So my thing is, if there are video clips in the app, I generally don’t choose it because I don’t know what’s going to show up on the videos.”

She continued, “I’m just as specific about apps as I am about the shows that they watch. Like if there’s a concept in there that shows any kind of disrespect, they don’t get to use it…. They have enough challenge in their lives to try and figure out how to do social things.” One participant lamented, “Why are we using a one size fits all app for 30 kids in this classroom?” She added that she felt some caution toward academic apps, “Maybe they’re [apps are] taking the place of things that would be more beneficial, especially if they become babysitters instead of tools. And I think it’s natural for that to happen, because during the pandemic, we went to this remote learning and people started using them more…. I think it just is important to remember that they’re just a tool and not a solution to all problems.”

Alongside general concerns about academic apps, participants also noted developmental concerns with apps because their children with autism experienced some developmental challenges. One participant stated, “I don't know if he’s going be nonverbal forever, so I’m hoping not, but I hope that him using the app doesn’t make it so he’s like, ‘Oh, I don’t need to say anything. This thing gets everything I need.”’ Another discussed social skills challenges and concerns using apps, “You’re not getting that human engagement or interaction. Really, it is with a computer-animated voice, and it is with a screen where you’re missing out on some of those social skills.”

Accessibility

The Accessibility theme represents available supports and ways in which it is challenging to receive supports for children with autism. Money was one challenge that participants noted. They described how they preferred to use free apps because of how expensive it could be to buy academic apps and how they spent a lot of money on

therapies for their children. One mother of a nonverbal child stated, “I understand they have to charge for them [apps] and stuff, but it doesn’t make sense to me. You don’t charge somebody to talk at school.” Similarly, parents reported that they preferred apps without ads because it was easy for their children to click on them accidentally. Participants also discussed figuring out the learning curve with some academic apps and using them with their children. All parents noted that technical issues created challenges for their children with autism, as they would repetitively push buttons, become easily frustrated, and the program may not register the correct answer even when the child pressed the right answer. When asked about autism-specific apps, participants reported that they had never heard about those types of apps. Parents also discussed accessibility challenges outside of apps, including delayed evaluation for autism, co-occurring learning disabilities, and lack of knowledge about early intervention.

Participants added some positive aspects to accessibility, such as how the school provided their children with a portable digital device to use academic apps. One parent noted how insurance was willing to pay for a portable digital device for her child with autism. Participants also noted that academic and communication apps created ways for their nonverbal children to communicate. Parents also noted how academic apps could be more accessible to children with autism if they were more individualized to each child’s needs. One parent stated, “This [app] isn’t actually meeting the needs of this child. Could we choose this other app or even the same app with different settings or something like that? You can have a little bit more control over what it was.”

Resources Used in Conjunction with Apps

This theme encompassed both academic and healthcare providers as well as non-technology tools that were used alongside apps. Providers that suggested or aided parents in using academic apps with their children include applied behavior analysis (ABA) therapists, speech-language pathologists, special education teachers, general education teachers, clinical and school psychologists, pediatricians, and early intervention specialists. Parents also discussed how schools, including autism-specific schools and special education preschools, aided them in using academic apps with their children.

Parents also discussed non-technology tools they used in conjunction with academic apps, including more traditional flash cards. Parents discussed using other paper methods, like drawing out shapes and asking their children to touch the correct shape. Parents discussed having a store of books alongside an app that has lots of books in it. One parent noted how they had to switch to some paper assignments and writing while homeschooling during the COVID-19 pandemic. Another parent generally discussed engaging in other forms of education, “We do other enrichment activities for learning, so I don’t know. I think that the amount that he’s doing is sufficient, so I haven’t looked into getting additional [apps].”

Future Development Ideas

This theme captures the ideas shared from the interview question “If you could discuss the creation of academic apps with scientists who design them, what are the most important things you would want to share regarding creating apps that work well for children with autism?” Parents discussed some aspects of apps that could help their children learn academic skills. One parent suggested that apps include spatial skills

puzzles, such as Tetris. She added that it would also be helpful if there was an app that showed letter sounds and her child could push the letter sounds together to aid with reading.

All parents noted that they wished there were more options for academic apps, and they also preferred when apps had a simple set-up and were generally user-friendly. This includes things like easy navigation, such as a home button. Parents frequently noted that it would be helpful if apps could get harder as their children progressed with academic material. One parent said, "One [an app] that really grows with the individual like level learning almost. If they have already mastered one plus one or five plus five, let's move on and get a little bit harder. What's 10 plus 12? You know, just a little bit harder. So, they're not just doing the really basic stuff all the time." She added, "I would love if the apps within themselves could just get more complex each time." Additionally, they reported that it may be useful to include an element of social-emotional learning in academic apps. For instance, one parent suggested that when an app provides praise, it could show a human face with a smile.

Parents also stated that they wished academic apps were more customizable for their children with autism. For instance, one parent wished apps were less distracting for her child, "He needs something that maybe has a little bit less frills and a little bit less moving things that he's trying to chase around the screen because instead of engaging him in the content that it's supposed to be teaching, that can be distracting to him." She continued, "But also if it's too bare bones, it's not going to be engaging. So just having, you know, black and white with just words or something isn't going to work either." One parent suggested that another area that could be customized could be voice recording and

replay. Along with customizability, parents thought it may be easiest to have one or two apps that cover nearly all academic areas rather than having to get a new academic app for each subject. Similarly, participants noted how academic apps could better focus on what they are trying to teach, like letter sounds or numbers, rather than just allowing children to use the process of elimination.

Table 6

Qualitative Themes and Codes

Themes (Number of Codes in Theme)	Codes/*Subcodes* (Number of Codes)
App Perspectives and Features (84)	App Pros (19) App Cons (13) App Features (52) *Academic Features (23)* *Non-Academic Features (29)*
Emotional Response to Apps (64)	User Experience (43) Caregiver Concerns (21) *Developmental Concerns (4)*
Accessibility (33)	Accessibility (33) *Communication (6)* *Technical Issues (5)*
Resources Used in Conjunction with Apps (28)	Health and Education Providers (20) Non-Technology Tools (8)
Future Development Ideas (18)	Future Development Ideas (18)

Discussion

This study investigated the phenomenon of being a caregiver of an autistic child who uses academic apps. When asked about their experiences, parents most frequently commented on the pros, cons, and useful features of academic apps. More surprisingly, parents appeared to have emotional responses and hesitancy to using academic apps. Likewise, they frequently noted how their children emotionally reacted when using academic apps, including both feelings of enjoyment and, at times, frustration. Another interesting topic that parents frequently discussed was the accessibility of academic apps, including comments about the price of academic apps, technology glitches, and how schools sometimes provide portable digital devices that can make academic apps more accessible to children with autism. Participants also commented on resources they used in conjunction with academic apps, including helpful school and health providers. Finally, parents provided some ideas about what features would be most useful to add to current or build into future academic apps. These conversations provide a view into a specific part of the experience of having a child with autism.

Overall, parents' responses frequently aligned with prior research. Results indicated that children with autism in this study typically enjoyed engaging with academic apps. One parent said, "The technology, it's like grabbing their attention and it keeps their attention." This mirrors the research on app-based learning, which indicates that children with autism generally find technology very appealing (Baron-Cohen, 2006; Fletcher-Watson et al., 2016; Neelyet al., 2013). One parent also discussed how they use a reading app while waiting for appointments with her child. Sergi et al. (2017) previously noted that parents often choose to have their children use academic apps

during waiting times or when the parents are completing other tasks. Additionally, when discussing app features, they appreciated, parents brought up colors, layout, and customizability, all features that a focus group of parents of children with autism noted in Boster and McCarthy (2018). Similarly, parents stated that apps could have distracting features, such as moving parts, bright colors, and patterns (Boster & McCarthy, 2018). Parents also wished that academic apps could grow with their children and track their progress along the way, something that previous studies have noted as a key ingredient for future apps for children with autism (Ennis-Cole & Parkman, 2012; Rehman et al., 2021). Finally, parents in this study stated their children used apps between 1-4 hours per week, similar numbers to previous research (Clark et al., 2015; Finke et al., 2015; Sergi et al., 2017). These statements from parents of children with autism that support previous research give credibility to the smaller sample size of this study.

One of the most revealing themes within the data was Accessibility. Parents frequently noted the expense of academic apps, especially those that aid with communication at school or those with more inclusive options. Other research has considered the low cost of academic apps (often only a few dollars) as a reason why parents may choose apps (Allen et al., 2016; Ferrari & Suzanne, 2017). However, parents in this study noted that they had so many other therapies and activities that they paid for that buying apps felt like a burdensome extra cost. It is important to note that these parents also had middle to high household incomes as well. These concerns are notable for app developers, as obtaining grants for app development for children with autism and making an app free of cost is much more appealing and accessible to parents of children with autism. Indeed, even academic apps with ads were less appealing to parents. For

those within low-income households, accessing academic apps may be even more challenging with cost, access to a portable digital device, or even lack of home internet service. However, it is important to note that some parents had monetary assistance from their insurance companies and some schools provided portable digital devices to their students at no cost. These accommodations may relieve some of the burden put on parents of children with autism, especially those from low-income families. Additionally, parents reported that they appreciated the portability of academic apps and their usefulness with multiple children with autism, which other studies have indicated make apps more appealing to parents (Ferrari & Suzanne, 2017; Stathopoulou et al., 2020).

It was also important to examine how children with autism engage with academic apps. One parent stated that her two children with autism both preferred and chose academic apps at times above other apps without educational content. This indicates that academic apps can be just as exciting and engaging for children with autism as apps that may be solely game-related (King et al., 2014). Additionally, parents noted that their children appeared to be more engaged with the academic apps if a parent was nearby, and they could spend time with a parent while using an academic app. This finding is like King et al. (2014) who found that students were more likely to use academic apps as intended if an adult was nearby. These findings are important for app developers as they continue to consider how best to engage children in academic work and recognize that shared learning experiences with adults could be useful tools in apps. Likewise, parents who want their children to engage with academic apps may find that their children enjoy using the app more when they can share their learning experience with their parents (Griffith & Arnold, 2019; Kucirkova et al., 2014).

When participants were asked about healthcare and education professionals that have helped them find and use academic apps, parents revealed that sometimes professionals helped them find apps, but few used apps in the context of their setting. For instance, one family had a pediatrician and psychologist who recommended a slew of academic apps for use at home, while another parent never had a healthcare provider recommend apps. One child with autism who was nonverbal did use academic apps with his speech-language pathologist, ABA therapist, and special education teacher. Likewise, another child used an academic app at school with his general education teacher. This finding is like previous research that indicates that professionals are more likely to provide app recommendations rather than use them in clinical settings (Clark et al., 2015). Healthcare providers may not provide app recommendations or use them in their setting because of the sheer number of possible apps, though many healthcare and school professionals find apps useful in their practice (Boster & McCarthy, 2018; Ferrari & Suzanne, 2017; Johnson, 2013). This indicates professionals need more training in using apps within their practice or classroom (Clark et al., 2015). For those providers looking to add academic app recommendations to their practice, we recommend consulting an article by Boudreaux et al. (2014) as they created a 7-step process to aid providers in researching apps and using them with patients.

When asked about how they choose academic apps for their children, parents had a variety of ways to determine which apps they thought were best. While research suggests that parents may not be wholly organized in their approach and take a "trial-and-error" method to find academic apps (Christon et al., 2010; Ennis-Cole & Parkman, 2012), this was simply not the case with parents in this study. Parents tended to receive

recommendations from healthcare providers and educators, as noted above, and they also did their own research on potential academic apps for their children with autism. In fact, parents discussed using a kind of vetting process for determining which apps were best suited for their children. One parent talked about how she had a choice between a few apps for her child, and she took the time to learn each app and weighed the pros and cons before deciding which one was more user-friendly, organized, and adaptable for her child. Another parent noted how she read the reviews when looking into academic apps and talked to other parents about what worked well for their children. She also talked about knowing specific developers and looking through the pictures before choosing academic apps. Likewise, one parent stated that she looked out for ads and videos in academic apps that might not be appropriate for her children. Finally, one parent said that she did not have a choice in an academic app her child used at school, and she did not feel like it was the best fit for her child with autism and was planning to talk to her child's teacher about alternative options. Though there is a multitude of sometimes overwhelming app options (Ennis-Cole & Parkman, 2012), parents of children with autism, at least in this study, appeared to be more discerning with academic apps than previous literature has indicated. However, when asked about autism-specific apps, parents had little knowledge that they existed, which has been noted in other studies (Martins et al., 2020). Additionally, since it appears that parents and professionals are looking into apps' research base, it is important to make research on academic apps readily available and easy to digest (Lubniewski et al., 2018; Robinson & Bond, 2017).

While the qualitative interview questions specifically asked about the pros and cons of using academic apps, it was somewhat surprising to hear that all participants had

concerns about academic apps beyond just the features within the apps. While they appreciated and supported their children in using the apps as previous studies have shown (Finke et al., 2015; Sergi et al., 2017), they were also somewhat hesitant about the consequences of using academic apps. A parent whose child was nonverbal worried that her child would come to rely on apps so much that he may not ever try to speak. Another parent was concerned about the social ramifications of using apps too much, as they do not offer the same level of social practice as face-to-face learning. They also mentioned the possibility of screen addiction. Both social and screen addiction concerns have been noted in other studies involving children with autism and app use (Gwynette et al., 2018; Sergi et al., 2017; Westby, 2021). Another parent lamented how apps and technology are not meant to "become babysitters instead of tools." These types of concerns are valid and may warrant further study so that professionals know how to work around these concerns and reassure parents of the benefits of academic apps.

Limitations and Future Research

This study has several limitations. A primary limitation was the small sample size. This study included three participants who had a total of five autistic children. While several other potential participants responded to the recruitment efforts in a Western state, most did not respond after receiving the informed consent documentation. Overall, it appears that several potential participants did not use academic apps with their children, did not have time to participate, or did not meet study inclusion criteria for some other reason. As this is a qualitative study, it was adapted to fit the small sample size so that the methodology included both elements of case study and phenomenology. Future qualitative and quantitative studies should include a larger sample size. Another

limitation was the homogeneity within the sample. Participants were White females with White male children. While all parents lived in the same area and experienced life with a child with autism, it would be interesting to learn more about the experiences of minoritized caregivers, father's experiences, other caregivers' experiences (grandparents, foster parents), and families with girls with autism. Future research should examine the experiences of these families and their children. Additionally, this data was collected in a suburban locale. Future studies could examine how access to resources in urban areas may impact parents' understanding and use of academic apps with their children with autism. The researchers could have also used further qualitative method standards, such as member-checks, further triangulation of the data, and having experts in the field comment on the themes and codes. These could have added to the strength of the study. Future studies should use these qualitative checks to improve their study quality.

Conclusions

This study contributes to the extant literature in several ways. First, it provides a view into how parents of children with autism view academic apps, including pros, cons, and useful features. Data from this study can be used to help app developers who create academic apps and autism-specific apps. It is particularly useful to understand what parents wish was included in academic apps, such as tracking progress or having more challenging material as a child learns. It is also helpful for professionals to better understand parents' views toward academic apps and provide more useful recommendations to parents. Understanding accessibility issues, such as cost, can be helpful when helping parents choose apps for their children. Likewise, it is helpful for parents to hear other parents' stories and validate their experiences of using academic

apps with their children. It is encouraging that parents are willing to share the successes of using academic apps with their children as well as their concerns regarding apps and technology. Future research may include a larger, more diverse sample to expand upon the findings of this study.

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CHAPTER V

FINAL SUMMARY AND CONCLUSIONS

This dissertation included three studies examining autistic children's use of academic apps. First, a meta-analysis examining the current literature on app-based academic interventions for autistic children ages 12 years and under provided strong evidence that academic apps greatly improve academic skills for children with autism with near immediate effect. Although we found significant results, there is clearly a need for more research on app-based academic apps for autistic children, as we only found 12 single-case design (SCD) studies in all. Consequently, a single-case design study with a multiple baseline design was then implemented with preschool children with autism. Specifically, interventionists used a number and letter learning app to teach academic skills. Results from the study did not show significant improvement in any area for most children. Null results may have been due to several factors, such as the app itself, attempting to allow independent app use, or the length of app use. Regardless, the multiple baseline design was sound, as it met the What Works Clearinghouse quality standards. However, it is just as important to present insignificant findings as it is to present significant findings to reduce publication bias (McClain et al., 2021). To comprehensively understand autistic children and academic app use, the final study was a qualitative study using a mixture of case-study and phenomenological designs. This study examined parent perspectives of using academic apps with their children with autism. Parents discussed the pros, cons, and best features of academic apps for children with autism. They also shared their insights into what app creators can do to make academic apps more user friendly and better overall for their autistic children. The findings from

this qualitative research can be useful for researchers, healthcare providers, app developers, and even other parents of autistic children.

These studies address several gaps in the autism literature. Technology interventions for autistic children are up-and-coming and rising in popularity in a variety of settings, such as in clinics, schools, and homes (Richards, 2013). Many technology interventions for autistic children are expensive, but apps present more cost-effective option (Goldsmith & LeBlanc, 2004; Neary & Scheuller, 2018) that are still engaging (Baron-Cohen, 2006). In addition, technology interventions often target social and adaptive skills, which are clearly important for autistic children, but these interventions may not include academic elements, which can also be challenging for many autistic children (Wei et al., 2012; Westerveld et al., 2018). As the meta-analysis showed, there is a paucity of literature on app-based academic interventions, especially with SCD studies even though this methodology is commonly applied in research with children who have disabilities and in schools to progress monitor intervention effectiveness. Indeed, the SCD study in this dissertation adds to that literature, despite insignificant results. Likewise, the qualitative study in this dissertation examined previously unexplored questions about how parents view academic apps for their autistic children. Each of these studies sheds more light into this area of research. Based on the findings from each study, researchers, clinical and school providers, and parents should continue to explore the use of academic apps as intervention for autistic children.

The Future of Academic Apps

While the meta-analysis showed that academic apps appear to work well in teaching academic skills to children with autism, it is important to note that these apps

may not work for every child with autism. Specifically, more research is needed on how academic app interventions can be improved through cultural adaptations. For instance, app developers should be aware to create a culturally diverse cast of characters in apps or provide an avatar creator that covers a range of racial/ethnic options (Fridenson-Hayo et al., 2017). A potentially effective alternative could be creating animal characters (Valiyamattam et al., 2020). Similarly, more options for spoken languages in academic apps could allow more autistic children, including immigrant children and English learners, to access academic apps (Zipke, 2014). App interventions that target reading could also modify the passages in apps to make them more culturally relevant to culturally and linguistically diverse children (Gibson et al., 2023). These are a few of many possibilities for culturally adapting future academic apps for autistic children.

Future apps should also consider cooccurring disabilities along with autism. While children with attention-deficit/hyperactivity disorder (ADHD) and autism in the meta-analysis in this dissertation showed significant improvement in academic skills when using an academic app intervention, challenges with hyper-focusing on technology may be a bigger challenge for children with autism and ADHD (Barnett, 2017). App developers may consider building breaks into their academic apps for students with these cooccurring disabilities (Barnett, 2017). Similarly, autistic children with a cooccurring intellectual disability may need more user-friendly and simplified versions of academic apps. Some examples of possible adjustments to academic apps include extra questions to create smaller steps to complete an academic task and buttons labeled with user-friendly pictures to aid with navigation (Stephenson & Limbrick, 2015). Cooccurring autism and a speech-language impairment may be one of the most challenging combinations, as this

study showed little improvement on a math intervention, and previous work has shown that children with both disabilities struggle to make gains in reading comprehension interventions (McClain et al., 2021). One study (Shane, 2006) suggested that visual displays, such as using pictures as much as possible to teach academic skills, rather than using symbols alone may be one possible adaptation to aid with academic learning. Surprisingly in the meta-analysis, no studies included autistic children with a cooccurring learning disability even though the included studies specifically focused on academic interventions. This is an area for future study that could not be examined in this dissertation.

When examining parents' perspective related to the future of academic apps for autistic children, access to free academic apps was important. While parents recognized that this was not always possible, they reported that it was their preference. This is important for app developers and app researchers to note, as gaining funds from grants or other sources to create academic apps will likely take some burden off parents with autistic children. Additionally, providing academic apps to schools at a discounted rate may also be helpful. If academic apps were integrated within schools as part of the curriculum, apps may be easier for families to access and afford, and cost may be less of a barrier. Other main suggestions from parents regarding future academic apps were that they wished the academic apps could be more individualized and would grow with their children. Individualizing academic apps toward autistic children might look like having options for brighter or more muted colors (Ntalindwa et al., 2021), simple and distraction-free navigation (Dattolo & Luccio, 2017), and a predictable presentation of information (Baron-Cohen, 2006; Dattolo & Luccio, 2017). It was surprising that all the

parents in this study had never heard of or used autism-specific apps. This is an area of growth for both future research and app developers. Autism-specific apps may become more popular and affordable with time. App developers should also take into consideration how they can create apps that grow with a child, possibly creating more and more challenging levels for academic skills, having new academic challenges for each grade level, and progress monitoring technology (Rehman et al., 2021). These suggestions from parents are important for researchers and app developers to take into consideration when studying what the most effective academic app intervention will look like for autistic children.

Overall, the studies included in this dissertation provide a glimpse into how clinicians, schools, and parents can use academic apps with autistic children. It also presents many ways in which future academic apps can be made to better suit individuals with autism. Technology and app interventions will likely continue to improve as more and more research is completed. This dissertation adds to the body of research in app creation and implementation and looks to the future for what new and up-and-coming academic apps will do for autistic children.

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CURRICULUM VITAE

Cassity R. Haverkamp

Education

Summer 2023 — **Doctor of Philosophy**
Psychology (specialization in School Psychology)
Utah State University
Dissertation: App-Based Academic Interventions for Children with Autism

December 2017 — **Master of Education**
Psychology (specialization in School Psychology)
Utah State University
Thesis: Comparing Two Emotion Identification Interventions for Children with Autism Spectrum Disorder

May 2016 — **Bachelor of Science**
Weber State University
Major: Psychology
Minor: Child Development

APA Accredited Doctoral Internship

High Plains Psychology Internship Consortium
Colorado Center for Assessment and Counseling
Fort Collins, CO
August 2021 – July 2022
Experience: Conducted two diagnostic intakes and psychological evaluations per week with children (up to age 18) referred for emotional, behavioral, academic, and social concerns related to psychological and neuropsychological conditions. Provided families with feedback and a psychological report based on the results of the evaluation. Provided ongoing individual and family pediatric psychotherapy services using a cognitive behavioral approach. Observed weekly group therapy sessions to gain knowledge about group therapy. Attended weekly consultation meetings to discuss ongoing therapy and assessment cases. Engaged in weekly individual, group, and peer supervision. Attended monthly consortium didactic sessions on a variety of topics in professional psychology.
Supervisors: Colleen Mondo, PhD and Jeremy Sharp, PhD

Practicum Experiences

Integrated Assessment Clinic
Behavioral Health Clinic
Sorenson Legacy Foundation Center for Clinical Excellence

Utah State University
Logan, UT
January 2020 – May 2021
Experience: Conducted, scored, and interpreted assessments with children and adults referred for concerns of autism and neurodevelopmental disorders as well as social-emotional/behavioral concerns. Discussed cases with interdisciplinary assessment team to determine testing plan and diagnostic decision making. Conducted diagnostic interviews and provided feedback to families. Specialized assessments administered and interpreted included the ADOS-2 and CARS-2.
Supervisor: Maryellen McClain Verdoes, PhD

University of Utah Neuropsychology Rehabilitation Clinic
Craig H. Neilsen Rehabilitation Hospital
University of Utah
Salt Lake City, UT
August 2020 – December 2020
Experience: Conducted intake interviews with patients ranging in age from adolescence to older adulthood. Conducted neuropsychological assessments with individuals with developmental disabilities, attention and memory difficulties, traumatic brain injury, stroke, and Alzheimer's disease. Wrote neuropsychological reports and engaged in group decision-making about diagnosis and recommendations. Attended weekly neuropsychology teaching rounds.
Supervisors: Summer Rolin, PsyD and Jeremy Davis, PsyD, ABPP

Outpatient Behavioral Pediatric Services
Behavioral Health Clinic
Sorenson Legacy Foundation Center for Clinical Excellence
Utah State University
Logan, UT
August 2019 – March 2020
Experience: Provided outpatient behavioral pediatric psychology care for children ages 3 to 12 years and their families. Primary diagnoses for children seen included oppositional defiant disorder, encopresis/enuresis, and adjustment disorder. Parent training was the main form of treatment provided in order to create behavioral change. Participated in group supervision once per week.
Supervisor: Clint Field, PhD

Social Language Intervention Group
Behavioral Health Clinic
Sorenson Legacy Foundation Center for Clinical Excellence
Utah State University
October 2019 – November 2019
Experience: Planned sessions each week examining topics and skills including social communication and language (e.g., how to tell a story with a beginning, middle, and end), responding to bullying, integrated eye contact and speech, and psychoeducation about

anxiety. Provided direct intervention services to adolescents with autism. Participated in group and individual supervision once per week.
Site Supervisor: Vicki Simonsmeier, MS, CCC-SLP/Aud
Faculty Supervisor: Maryellen McClain Verdoes, PhD

Autism Support Services: Education, Research, and Training (ASSERT) Program
Logan, UT
November 2018 – August 2019
Experience: Provided direct applied behavior analysis (ABA) services to preschool children with autism under the supervision of Board-Certified Behavior Analysts. Attended group supervision meetings to learn new programming. Attended individual supervision once per week.
Site Supervisor: Thomas S. Higbee, PhD, BCBA-D, LBA
Faculty Supervisor: Maryellen McClain Verdoes, PhD

School Psychology Advanced Practicum
Box Elder School District
Brigham City, UT
September 2018 – November 2018
Experience: Administered, scored, and interpreted cognitive and academic achievement assessments. Performed classroom observations within general education, special education, and behavior support classrooms. Prepared and scored behavioral and social-emotional rating scales, interpreted and presented evaluation results at IEP meetings, and assisted in audit review paperwork. Assessment cases were specialized in nature (students with genetic disorders, challenging behaviors, and co-occurring disorders) to provide a more advanced school experience.
Site Supervisor: Marietta Veeder, PhD
Faculty Supervisor: Maryellen McClain Verdoes, PhD

School Psychology Practicum
Heritage Elementary School, Centerville Elementary School, and Taylor Elementary School
Davis School District
Layton, UT and Centerville, UT
September 2017 – April 2018
Experience: Administered cognitive assessments for students, performed classroom observations, and prepared and scored behavioral and social-emotional rating scales. Attended IEP meetings and presented evaluation results at IEP meetings. Led an emotion regulation group for 2nd grade students using the Zones of Regulation manual, assisted with a school-wide PBIS program, and consulted with teachers to implement behavior intervention plans.
Site Supervisor: Sara Doty, PhD, NCSP
Faculty Supervisor: Donna Gilbertson, PhD

Utah State University Psychology Community Clinic
Logan, UT

May 2017 – September 2017
Experience: Worked on assessment and clinical cases. Conducted clinical interviews with clients. Provided individual and family therapy services using a CBT model. Administered cognitive, academic achievement, and common rating scale assessments. Provided feedback to clients on evaluation results. Wrote case notes and an integrated report.
Site Supervisors: Gretchen Peacock, PhD and Sara Boghosian, PhD

School Psychology Introductory Practicum
Cache School District
Cache County, UT
March 2017 – April 2017
Experience: Shadowed a school psychologist in Cache School District. Performed cognitive and academic achievement assessments, classroom behavior observations, and attended IEP meetings.
Site Supervisor: Chris Milbank, EdS
Faculty Supervisor: Donna Gilbertson, PhD

Other Clinical Experiences

Utah Regional Leadership Education in Neurodevelopmental and Related Disabilities (URLEND) – Autism Enhanced Track
Logan, UT
August 2020 – April 2021
Experience: Accrued 150 hours over the course of two semesters in second year LEND training experience. Activities included participation in regional didactic seminars each week on topics related to autism, conducting a research project (qualitative examination of ECHO – Rural Providers participant experiences), receiving formal training in the CARS-2, presenting on interdisciplinary work in autism, observing clinical practices in autism, and facilitating ECHO – Rural Providers sessions once per month.
Faculty Mentor: Terisa Gabrielsen, PhD, NCSP

Utah Regional Leadership Education in Neurodevelopmental and Related Disabilities (URLEND)
Logan, UT
August 2018 – May 2019
Experience: Accrued 300 hours over the course of two semesters as a trainee in the LEND program. Participated in regional didactic seminars each week, conducted a research project (interdisciplinary trainees' knowledge of autism spectrum disorder), participated in interdisciplinary clinic visits, worked one-on-one with a family of a child with a medical disability, participated in two interdisciplinary parent-directed consultations, and presented to a diverse community group about a topic related to children and youth with special health care needs (respite care in Utah).
Faculty Mentor: Maryellen McClain Verdoes, PhD

Teaching Experiences

Course Instructor
Utah State University – PSY 3500, Research Methods in Psychology
Logan, UT
Spring 2021
Experience: Taught an online undergraduate level upper division course in research methods in psychology. Developed syllabus, online lecture materials, writing assignments, and exams with assistance from faculty.
Faculty Supervisor: Scott Bates, PhD

Teaching Assistant
Utah State University – PSY 6310, Intellectual Assessment
Logan, UT
Fall 2020
Experience: Conducted weekly labs instructing students in the WAIS-IV, WISC-V, and WPPSI-IV in a graduate level course on intellectual assessment. Met with students individually to pass off on administering cognitive assessments. Graded and provided feedback on student administration, scoring, and mock report writing.
Faculty Supervisor: Marietta Veeder, PhD

Teaching Assistant
Utah State University – PSY 3500, Research Methods in Psychology
Logan, UT
Spring 2020
Experience: Graded student work and provided extensive feedback on student research proposals. Met with students individually during office hours to discuss their research project ideas. Guest lectured for course instructor. Developed lecture materials based on provided templates.
Faculty Supervisor: Scott Bates, PhD

Course Instructor
Utah State University – PSY 3210, Abnormal Psychology
Logan, UT
Fall 2019
Experience: Taught an undergraduate level upper division course in abnormal psychology. Created syllabus with assistance from faculty, developed lecture materials and exams, and graded student work.
Faculty Supervisor: Scott Bates, PhD

Guest Lecturer
Utah State University – PSY 6810, Advanced Assessment of Autism Spectrum Disorder
Logan, UT
Fall 2018
Experience: Guest lectured for a graduate level course in advanced assessment of autism spectrum disorder. Developed lecture materials for a talk on school-based autism

assessment and variation in assessment techniques and strategies between school districts in the state of Utah.
Instructor: Maryellen McClain Verdoes, PhD, LP
Faculty Supervisor: Scott Bates, PhD

Publications

Book Chapters
McClain, M. B., **Haverkamp, C. R.**, Holt, J., Peacock, G. G., & Winter, S. (2020). Interprofessional care and education. In M. B. McClain, J. D. Shahidullah, & K. R. Mezher (Eds.), *Handbook of interprofessional care for pediatric ASD* (pp. 369-383). Springer.

Peer-Reviewed Journal Articles
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McClain, M. B., Harris, B., Schwartz, S. E., **Haverkamp, C. R.**, & Golson, M. E. (2019). Development and validation of the Autism Spectrum Knowledge Scale – Professional Version: Preliminary analyses. *Open Science Framework*, 1-36. https://doi.org/10.17605/OSF.IO/8M9UB

Conference Proceedings

Atashpanjeh, H., Behfar, A., **Haverkamp, C. R.**, McClain, M. B., & Al-Ameen, M. N. (2022). Intermediate help with using digital devices and online accounts: Understanding the needs, expectations, and vulnerabilities of young adults. In Moallem, A. (Eds.), *HCI for cybersecurity, privacy and trust. HCII 2022. Lecture notes in computer science* (Vol. 13333; pp. 3-15). Springer. https://doi.org/10.1007/978-3-031-05563-8_1

In Review

Haverkamp, C. R., Roanhorse, T. T., McClain, M. B., Harris, B., Bakner, K. E., Benney, C. M., Golson, M. E. (in review). How does culture impact school-based autism evaluations? Perspectives from school psychologists. Submitted to *Psychology in the Schools.*

Haverkamp, C. R., Golson, M. E., McClain, M. B., & Schwartz, S. E. (in review). An app-based early academic skills intervention for children with autism. Submitted to *Contemporary School Psychology.*

Professional Conference Presentations

International Presentations

Haverkamp, C. R., McClain, M. B., Leopold, S. Y., & Schwartz, S. (2019, May). *The effects of background noise on reading in children with autism spectrum disorder.* Poster presented at the International Society for Autism Research 2019 Annual Meeting, Montreal, Québec, Canada.

McClain, M. B., & **Haverkamp, C. R.** (2019, May). *Reading skills in children & adolescents with autism spectrum disorder (ASD)*. Poster presented at the International Society for Autism Research 2019 Annual Meeting, Montreal, Québec, Canada.

National Presentations

Haverkamp, C. R., Golson, M. E., & McClain, M. B. (2020, February). *An app-based early academic skills intervention for children with ASD*. Paper presented at the 2020 National Association of School Psychologists Annual Convention, Baltimore, MD.

Haverkamp, C. R., Benney, C. M., McClain, M. B., & Otero, T. L. (2020, February). *Single-case design in school psychology journals: 2010-2018*. Poster presented at the 2020 National Association of School Psychologists Annual Convention, Baltimore, MD.

McClain, M. B., **Haverkamp, C. R.**, Benallie, K. J., Benney, C. M., & Harris, B. (2020, February). *School-based ASD assessment of culturally and linguistically diverse students*. Paper presented at the 2020 National Association of School Psychologists Annual Convention, Baltimore, MD.

Roanhorse, T. T., Benallie, K. J., **Haverkamp, C. R.**, Golson, M. E., & McClain, M. B. (2020, February). *American Indians' perceptions of disabilities: A review and proposed*

study. Poster presented at the 2020 National Association of School Psychologists Annual Convention, Baltimore, MD.

Benallie, K. J., Golson, M. E., Roanhorse, T. T., **Haverkamp, C. R.**, & McClain, M. B. (2020, February). *A systematic review of American Indians in school psychology research*. Poster presented at the 2020 National Association of School Psychologists Annual Convention, Baltimore, MD.

Haverkamp, C. R., Lindsey, R., Bono, L. K., Freedman, R., McClain, M. B., Simonsmeier, V., & Ortiz, E. (2019, November). *Current levels and perceptions of ASD knowledge among LEND and UCEDD trainees*. Poster presented at the Association of University Centers on Disabilities (AUCD) 2019 Annual Meeting, Washington, DC.

McClain, M. B., Shahidullah, J., Mezher, K. R., **Haverkamp, C. R.**, & Benallie, K. J. (2019, August). *School psychologists' perspectives of coordinated care in providing services to students with ASD*. Symposium presented at the 2019 American Psychological Association Annual Meeting, Chicago, IL.

Bono, L. K., Freedman, R., **Haverkamp, C. R.**, Lindsey, R., McClain, M. B., & Simonsmeier, V. (2019, March). *Assessing ASD knowledge of LEND & UCEDD trainees with the Autism Spectrum Knowledge Scale: Professional Version-Revised (ASKSP-R)*. Poster presented at the 2019 Association for Maternal & Child Health Programs Annual Conference, San Antonio, TX.

Haverkamp, C. R., & McClain, M. B. (2019, February). *Comparing two emotion identification interventions for children with ASD*. Paper presented at the 2019 National Association of School Psychologists Annual Convention, Atlanta, GA.

Cavender, S., **Haverkamp, C. R.**, McClain, M. B., Harris, B., & Otero, T. (2019, February). *Assessing graduate training on ASD assessment through syllabi content analysis*. Poster presented at the 2019 National Association of School Psychologists Annual Convention, Atlanta, GA.

Golson, M. E., **Haverkamp, C. R.**, & McClain, M. B. (2019, February). *Effectiveness of a letter-writing app intervention for children with ASD*. Poster presented at the 2019 National Association of School Psychologists Annual Convention, Atlanta, GA.

Benney, C. M., Cavender, S., Heyborne, M., **Haverkamp, C. R.**, McClain, M. B. (2019, February). *Mindfulness on academic stress and reading for students with specific learning disabilities*. Poster presented at the 2019 National Association of School Psychologists Annual Convention, Atlanta, GA.

Haverkamp, C. R., & McClain, M. B. (2018, February). *Emotion identification interventions for children with autism spectrum disorder.* Poster presented at the 2018 National Association of School Psychologists Annual Convention, Chicago, IL.

McClain, M. B., **Haverkamp, C. R.**, & Harris, B. (2018, February). *Knowledge of autism spectrum disorder and preservice school psychology trainees.* Paper presented at the 2018 National Association of School Psychologists Annual Convention, Chicago, IL.

McClain, M. B., Schatz, R. B., & **Haverkamp, C. R.**, & Yoho, S. E. (2018, February). *Reading skills and background noise: Children with autism spectrum disorder.* Paper presented at the 2018 National Association of School Psychologists Annual Convention, Chicago, IL.

Regional and State Presentations
McClain, M. B., & **Haverkamp, C. R.** (2017, January). *Differential diagnosis when ASD is the referral question.* Presentation at the Autism Translational Research Workshop, Provo, UT.

Haverkamp, C. R., Tubbs, B., & McGillivray, S. (2016, April). *Memory strategies for college students*. Poster session presented at the Rocky Mountain Psychological Association Convention, Denver, CO.
Haverkamp, C. R., Tubbs, B., & McGillivray, S. (2016, February). *Memory strategies for college students*. Poster session presented at the Utah Conference on Undergraduate Research, Salt Lake City, UT.

Haverkamp, C. R., Drysdale, L. L., & Baldwin, N. (2015, March). *Suicide: Signs, prevention, and coping.* Poster session presented at the Utah Early Childhood Conference, Ogden, UT.

Presentations – Local
Haverkamp, C. R., & Shaw, L. A. (2016, April). *Social information-processing and attachment theories: Their connection and relations to learning disabilities and autism spectrum disorder*. Paper presented at the Weber State University Psychology Research Symposium, Ogden, UT.

Haverkamp, C. R., Tubbs, B., & McGillivray, S. (2016, April). *Memory strategies for college students*. Poster session presented at the Weber State University Psychology Research Symposium, Ogden, UT.

Haverkamp, C. R., Tubbs, B., & McGillivray, S. (2016, March). *Memory strategies for college students*. Poster session presented at the Weber State University Annual Undergraduate Research Symposium and Celebration, Ogden, UT.

Eddy, C., **Haverkamp, C. R.**, Horstman, A., Moorer, A., Rowley, N., Sill, J., Twamley, B., Russell-Stamp, M., & Parrilla de Kokal, M. (2015, April). *Implementing goal setting*. Poster session presented at the Weber State University Center for Community Engaged Learning Symposium, Ogden, UT.

Eddy, C., **Haverkamp, C. R.**, Horstman, A., Moorer, A., Rowley, N., Sill, J., Twamley, B., Russell-Stamp, M., & Parrilla de Kokal, M. (2015, April). *Emotional understanding in children*. Poster session presented at the Weber State University Center for Community Engaged Learning Symposium, Ogden, UT.

Service

Utah State University School Psychology Student Association Recruitment Chair
Logan, UT
Spring 2018 – Spring 2020
Experience: Involved in student recruitment for the USU School Psychology Program. Responsibilities included creating and distributing flyers and brochures, promoting the program by speaking in undergraduate classrooms, and representing the program at events.
Faculty Mentor: Maryellen McClain Verdoes, PhD

Planning Committee for Autism Diagnostic Observation Scale, 2nd Edition, Training
Utah State University
Logan, UT
Summer 2019
Experience: Attended committee meetings to plan a formal ADOS-2 training with a certified trainer. Communicated with building and university events staff in order to successfully bring a regional training to Utah State University. Handled distribution of materials throughout the training. Problem-solved with the planning team when challenges arose.
Planning Committee: Maryellen McClain Verdoes, PhD, Gretchen Peacock, PhD, and Vicki Simonsmeier, MS, CCC-SLP/Aud

Psi Chi Vice President
Weber State University Chapter
Fall 2015 – Spring 2016
Experience: Assisted the Psi Chi president in running meetings and organizing events. Acted in a leadership role in the Psi Chi Club at Weber State University. Collaborated on a student-led research project and presented this project at multiple conferences.

Undergraduate Practicum at Youth Impact Afterschool Program
Ogden, UT
Spring 2015
Experience: Volunteered 70 hours with at-risk youth in a variety of settings including tutoring high school students and teaching social skill training lessons on goal setting and emotions. Assisted in creating and implementing an activity in which children reflected on attainable future goals such as a college education.
Supervisors: Melinda Russell-Stamp, PhD and Maria Parrilla de Kokal, PhD

Gear Up Student Mentor
Ogden High School
Ogden, UT
Fall 2014
Experience: Tutored low-achieving high school students in math, English, and science. Discussed the benefits of a college education and acted as a collegiate mentor.
Supervisor: Paul Schvaneveldt, PhD

Peer Reviewer

Psychology in the Schools, article reviews with Dr. Maryellen McClain Verdoes, Fall 2017, Spring 2019, Spring 2020

Journal of Autism and Developmental Disorders, article reviews with Dr. Maryellen McClain Verdoes, Spring 2018, Spring 2019, Fall 2019

National Association of School Psychologists Annual Convention, convention proposal reviews, Summer 2018, Summer 2019, Summer 2020

Attendance at Trainings and Professional Development

Fundamentals of Structured TEACCHing
Spring 2021
University of Utah and University of North Carolina-Chapel Hill (via teleconference)
UNC TEACCH Autism Program
Trainers: Various Trainers from UNC TEACCH Autism Program

Childhood Autism Rating Scale, Second Edition (CARS-2) Training
Fall 2020
University of North Carolina-Chapel Hill (via teleconference)
UNC TEACCH Autism Program
Trainers: Mary E. Van Bourgondien, PhD and Michele E. Villalobos, PhD

Question, Persuade, and Refer (QPR) Training
Fall 2018
Mount Logan Middle School
Trainer: Bear River Mental Health

Utah State University Grant Writing Workshop
Fall 2018
Utah State University
Trainer: M. S. AtKisson, PhD

ADOS–2 Introductory/Clinical Workshop
Summer 2018
Brigham Young University
Trainer: Courtney Burnette, PhD

Awards, Scholarships, and Grants

Fall 2020 – LaPray Scholarship, Department of Psychology, Utah State University
Spring 2019 – Graduate Research and Creative Opportunities Grant, Utah State University

Spring 2018 – Kenneth W. Merrell Scholarship, Department of Psychology, Utah State University
Fall 2017 – NASP Graduate Student Research Grant

Appendices

Appendix A. Qualtrics Demographic Survey

Demographic Survey

Start of Block: IC

Q30 **Parents' Perceptions and Use of App-Based Academic Interventions with Their Children with ASD**
You can download the informed consent from this link 11513 mcclain ic final
You are invited to participate in a research study by Maryellen McClain Verdoes, PhD, an assistant professor in Psychology Department at Utah State University, and Cassity R. Haverkamp, MEd, a graduate student in the Psychology Department at Utah State University.The purpose of this research is to better understand primary caretakers' (e.g., parents, grandparents) perceptions, including possible benefits of and barriers to, using academic applications for children with autism spectrum disorder (ASD) in the home setting. Specifically, we are interested in learning about current academic applications used in the home setting, what features make these applications well suited for children with ASD, and how primary caretakers' and professionals can work together to find effective academic applications for children with ASD. You are being asked to participate in this research because you are the primary caretaker of a child with ASD who lives in the state of Utah.Your participation in this study is voluntary and you may withdraw your participation at any time for any reason.If you take part in this study, you will be asked to complete a brief online demographics survey and answer questions during a virtual interview. After you complete the informed consent, you will be automatically taken to the demographics survey. The survey will take approximately 5 minutes. The interview will take 60-90 minutes and will be completed in one session. The total time commitment is expected to be 65-95 minutes. Before you read this form, you responded to some questions regarding you and your child and their use of academic apps. Researchers will maintain that data once you agree to enter the full study.The possible risks of participating in this study include loss of confidentiality and possible fatigue (i.e., may need a break during the interview). Although you will not directly benefit from this study, it has been designed to learn more about caregivers' perceptions of using academic apps with their children with ASD. **We will make every effort to ensure that the information you provide remains confidential**. We will not reveal your identity in any publications, presentations, or reports resulting from this research study. However, it may be possible for someone to recognize the specifics you share with us. **We will collect your information through** a phone screening, a Qualtrics demographic survey, and video/audio recordings of the Zoom interview. Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This information and survey data will be securely stored in a restricted-access folder on Box.com, an encrypted, cloud-based storage system. This form will be kept for three years after the study is complete, and then it will be destroyed. Identifiable data, including audio and video data and personally identifying information,

will be kept until this project is complete (about five years), and then it will be destroyed. Only de-identified demographic information and digital transcripts will be retained. These de-identified data may be used or distributed for future research without additional consent from you. If you do not wish for us to use your information in this way, please state so below. **For your participation in this research study, you will receive** a $15 Amazon.com electronic gift card. After completion of the interview portion of the study, we will send the gift card to you using your preferred email address. You will not receive compensation if you do not complete the interview portion of the study due to withdrawal or termination. You can decline to participate in any part of this study for any reason and can end your participation at any time. **The researchers would like to keep your contact information** to invite you to participate in future research studies. If you would like them to keep your contact information, please indicate below. This information will be entered into a database of participants who may be contacted in the future kept in a secure Box.com folder that is completely separated from anything to do with this research study and maintained until you ask to be removed. You can contact the Principal Investigator at any time to be removed from this list. If you have any questions about this study, you can contact the Principal Investigator at 435-797-0396 or maryellen.mcclainverdoes@usu.edu. Thank you again for your time and consideration. If you have any concerns about this study, please contact Utah State University's Human Research Protection Office at (435) 797-0567 or irb@usu.edu.

○ I do not agree to allow my de-identified information to be used or shared for future research. (1)

○ I agree to allow my contact information to be retained and used for communication about future research opportunities. (2)

Q33 By signing below and continuing to the demographics survey, you agree that you are 18 years of age or older and wish to participate. You agree that you understand the risks and benefits of participation, and that you know what you are being asked to do. You also agree that if you have contacted the research team with any questions about your participation and are clear on how to stop your participation in this study if you choose to do so. Please be sure to retain a copy of this form for your records.

Skip To: End of Survey If By signing below and continuing to the demographics survey, you agree that you are 18 years of ag... Is Displayed

---

Q32 Name (First and Last)

_____

Q31 Date (mm/dd/yyyy)

_____

End of Block: IC

Start of Block: Demographic Questionnaire

Q1 What is your age (in years)?

_____

Q20 In what city and state do you reside? (For example: Logan, UT)

_____

Q2 How do you currently describe your gender identity?

- Male (1)
- Female (2)
- Prefer not to respond (3)
- Other (4)

Display This Question:

If How do you currently describe your gender identity? = Other

Q3 If other, please describe:

_____

Q4 What is your race/ethnicity? Please select all that apply:

- ☐ American Indian or Alaska Native (1)
- ☐ Asian (2)
- ☐ Black or African American (3)
- ☐ Native Hawaiian and Other Pacific Islander (4)
- ☐ White (5)
- ☐ Multiracial (6)
- ☐ Latino/a (7)
- ☐ Other (8)

Display This Question:

If What is your race/ethnicity? Please select all that apply: = Other

Q5 If other, please describe:

_____

Q14 What is your marital status?

- ○ Married or domestic partnership (1)
- ○ Single/never married (2)
- ○ Divorced (3)
- ○ Widowed (4)
- ○ Separated (5)
- ○ Prefer not to respond (6)

Q15 What is your estimated net family income?

- ○ Less than $20,000 (1)
- ○ $20,000 to $34,999 (2)
- ○ $35,000 to $49,999 (3)
- ○ $50,000 to $74,999 (4)
- ○ $75,000 to $99,999 (5)
- ○ Greater than $100,000 (6)
- ○ Prefer not to respond (7)

Q16 What is the highest level of education you have received?

- ○ Less than high school (1)
- ○ High school graduate/GED (2)
- ○ Some college/trade school/associate's degree (3)
- ○ College graduate/bachelor's degree (4)
- ○ Graduate or professional degree (5)

Q6 How many children do you have?

_____

Q7 How many children do you have with autism spectrum disorder?

_____

Q8 For the next few questions, please answer based on your youngest child with autism spectrum disorder who is at least 3 years or older and uses academic apps.

Q9 What is your child's age (in years)?

_____

Q17 If your child is currently in school, in what grade are they?

- ○ Preschool (1)
- ○ Kindergarten (2)
- ○ 1st grade (3)
- ○ 2nd grade (4)
- ○ 3rd grade (5)
- ○ 4th grade (6)
- ○ 5th grade (7)
- ○ 6th grade (8)
- ○ 7th grade (9)
- ○ 8th grade (10)
- ○ 9th grade (11)
- ○ 10th grade (12)
- ○ 11th grade (13)
- ○ 12th grade (14)
- ○ Post secondary school (15)
- ○ Not in school (16)

Q22 Does your child have any co-occurring formal diagnoses such as intellectual disability, learning disorder, or ADHD?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Does your child have any co-occurring formal diagnoses such as intellectual disability, learning... = Yes

Q23 If Yes, what diagnosis?

_____

Q24 Does your child receive any special education services at school?

- ○ Yes (1)
- ○ No (2)
- ○ They are currently on a 504 plan (3)

Display This Question:

If Does your child receive any special education services at school? = Yes

Q25 If Yes, under what SPED eligibility category?

_____

Q10 How do you currently describe your child's gender identity?

- ○ Male (1)
- ○ Female (2)
- ○ Prefer not to respond (3)
- ○ Other (4)

Display This Question:

If How do you currently describe your child's gender identity? = Other

Q11 If other, please describe:

_____

Q12 What is your child's race/ethnicity? Please select all that apply:

- ☐ American Indian or Alaska Native (1)
- ☐ Asian (2)
- ☐ Black or African American (3)
- ☐ Native Hawaiian and Other Pacific Islander (4)
- ☐ White (5)
- ☐ Multiracial (6)
- ☐ Latino/a (7)
- ☐ Other (8)

Display This Question:

If What is your child's race/ethnicity? Please select all that apply: = Other

Q13 If other, please describe:

_____

Q18 How many hours per week does your child use a portable digital device (e.g., mobile phone, tablet)?

- ○ 1 hour or less (1)
- ○ 2-3 hours (2)
- ○ 4-5 hours (3)
- ○ 6-7 hours (4)
- ○ 8-9 hours (5)
- ○ 10-11 hours (6)
- ○ 12-13 hours (7)
- ○ 14 or more hours (8)

Q21 When was the last time your child regularly (i.e., at least once per week for 4 weeks) used an academic app?

- ○ This week (1)
- ○ Last week (2)
- ○ Two weeks ago (3)
- ○ About 4 weeks ago (4)
- ○ About 8 weeks ago (5)
- ○ About 12 weeks ago (6)

Q29 You will receive a call from a researcher after you complete this demographic form to schedule your individual interview. The next few questions will help the researcher determine times that may work to conduct your interview.

Q26 What time of day would be most convenient for your interview?

- ☐ Mornings (1)
- ☐ Afternoon (2)
- ☐ Evenings (3)

Q27 Do you have a preference for which day of the week you will participate in the interview? (Choose all days you prefer)

- ☐ Monday (1)
- ☐ Tuesday (2)
- ☐ Wednesday (3)
- ☐ Thursday (4)
- ☐ Friday (5)
- ☐ Saturday (6)
- ☐ Sunday (7)

Q28 Do you have any comments about scheduling (i.e., planned vacations, days you are definitely not available) that the researchers should know before calling to schedule your interview?

_____

_____

_____

_____

_____

End of Block: Demographic Questionnaire

Appendix B. REDCap Data Entry Form for Meta-Analysis

Data Dictionary Codebook

04/07/2023 10:23pm

#Variable / Field Name	Field Label *Field Note*	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)

Instrument: Study Data Entry App MA (study_data_entry_app_ma)

1	[record_id]	Record ID	text
2	[study_id]	Paper (Last name of first author, year) (e.g., Jones2015)	text
3	[study_type]	Study Design	radio, Required

10	Multiple Baseline
20	Alternating Treatments
30	ABAB Reversal
40	Other

4	[wwc_study]	WWC Classification	radio, Required

10	Meets Fully
20	Meets with Reservations
30	Does not Meet

5	[study_data_entry_app_ma_complete]	Section Header: *Form Status* Complete?	dropdown

0	Incomplete
1	Unverified
2	Complete

Instrument: Child Data Entry App Ma (child_data_entry_app_ma)

6	[sub_id]	Subject (Pseudonym First Name)	Required
7	[sub_race_eth]	Race/Ethnicity	checkbox, Required

8	[sub_race_eth_other] Show the field ONLY if: [sub_race_eth(80)] = '1'	If Other, please describe:	text radio, Required
9	[sub_dx]	Diagnosis	

10	sub_race_eth ___10	American Indian or Alaska Native
20	sub_race_eth ___20	Asian
30	sub_race_eth ___30	Black or African American
40	sub_race_eth ___40	Hispanic, Latino or Spanish Origin
50	sub_race_eth ___50	Middle Eastern or North African
60	sub_race_eth ___60	Native Hawaiian or Other Pacific Islander
70	sub_race_eth ___70	White
80	sub_race_eth ___80	Other
90	sub_race_eth ___90	NA

10	ASD or Asperger's or PDD-NOS
20	ASD and SLI
30	ASD and SLD
40	ASD and ADHD
45	ASD and ID
50	ASD and Something Else

10	[sub_dx_other] Show the field ONLY if: [sub_dx] = '50'	If another disorder, please describe:	text
11	[sub_iq]	IQ score (e.g., Standard Score) *Leave blank if not reported*	text (number, Min: 40, Max: 160)
12	[sub_age]	Age in months	text (number, Min: 0, Max: 264)
13	[sub_age_years]	Age in years	text (number, Min: 0, Max: 22)
14	[sub_grade]	Grade	radio 10 Preschool 20 K 30 1st 40 2nd 50 3rd 60 4th 70 5th 80 6th 90 7th 10 8th
15	[grade_other] Show the field ONLY if: [sub_grade] = '160'	If other please describe:	text
16	[sub_gend]	Gender	radio 10 Male 20 Fema
17	[sub_gend_other] Show the field ONLY if: [sub_gend] = '30'	If other, please describe:	text
18	[sub_setting]	Setting	radio, Required 10 Urban 20 Suburban

19	[setting_other] Show the field ONLY if: [sub_setting] = '40'	If other, please describe:	text

20	[sub_length]	Length of each session (in minutes)	subject)
21	[sub_length2]	If other, what was the length of each session (in minutes)	
	Show the field		
22 23	ONLY if: [sub_length] = '120' [time_numb] [phase_1]	How many time points were observed? Phase 1	
24 25	[phase_1_days] [phase_2]	How many time points in Phase 1? Phase 2	
26 27	[phase_2_days] [phase_3]	How many time points in Phase 2? Phase 3	
	Show the field ONLY if: [time_numb] >= 3		
28 29 30	[phase_3_days] [measure_numb] [domain_1]	How many time points in Phase 3? How many domains are measured across time? Domain 1 (academic	

radio

10	10
20	15
30	20
40	25
50	30
60	35
70	40
80	45
90	50
100	55
110	60
120	Other

text

text
(number,
Min: 2, Max:
75),
Required
radio

text
(number,
Min: 0, Max:
75),
Required
radio

text (number, Min: 0,
Max: 75), Required radio

text (number, Min: 0,
Max: 75)

text
(number,
Min: 1, Max:
5), Required

radio, Required

10	Baseline
20	Intervention 1

10	Baseline
20	Intervention 1

10	Baseline
20	Intervention 1

10	Reading comprehension
20	Reading fluency
30	Math calculation

31	[domain_other_1] Show the field ONLY if: [domain_1] = '80'	If other, please describe:	text
32	[perc_1_1]	Percent Correct at Time 1 for [domain_1]	text (number, Min: 0, Max: 100)
33	[correct_1_1]	Number Correct at Time 1 for [domain_1]	text (integer, Min: 0, Max: 100)
34	[outof_1_1]	Out of what number at Time 1 for [domain_1]	text (number, Min: 0, Max: 100)
35	[perc_1_2] Show the field ONLY if: [time_numb] >= 2	Percent Correct at Time 2 for [domain_1]	text (number, Min: 0, Max: 100)
36	[correct_1_2] Show the field ONLY if: [time_numb] >= 2	Number Correct at Time 2 for [domain_1]	text (integer, Min: 0, Max: 100)
37	[outof_1_2] Show the field ONLY if: [time_numb] >= 2	Out of what number at Time 2 for [domain_1]	text (number, Min: 0, Max: 100)
38	[perc_1_3] Show the field ONLY if: [time_numb] >=3	Percent Correct at Time 3 for [domain_1]	text (number, Min: 0, Max: 100)
39	[correct_1_3] Show the field ONLY if: [time_numb] >=3	Number Correct at Time 3 for [domain_1]	text (integer, Min: 0, Max: 100)
40	[outof_1_3] Show the field ONLY if: [time_numb] >=3	Out of what number at Time 3 for [domain_1]	text (number, Min: 0, Max: 100)
41	[perc_1_4] Show the field ONLY if: [time_numb] >=4	Percent Correct at Time 4 for [domain_1]	text (number, Min: 0, Max: 100)
42	[correct_1_4] Show the field ONLY if: [time_numb] >=4	Number Correct at Time 4 for [domain_1]	text (integer, Min: 0, Max: 100)
43	[outof_1_4] Show the field ONLY if: [time_numb] >=4	Out of what number at Time 4 for [domain_1]	text (number, Min: 0, Max: 100)
44	[perc_1_5] Show the field ONLY if: [time_numb] >=5	Percent Correct at Time 5 for [domain_1]	text (number, Min: 0, Max: 100)
45	[correct_1_5] Show the field ONLY if: [time_numb] >=5	Number Correct at Time 5 for [domain_1]	text (integer, Min: 0, Max: 100)
46	[outof_1_5] Show the field ONLY if: [time_numb] >=5	Out of what number at Time 5 for [domain_1]	text (number, Min: 0, Max: 100)
47	[perc_1_6] Show the field ONLY if: [time_numb] >=6	Percent Correct at Time 6 for [domain_1]	text (number, Min: 0, Max: 100)

48	[correct_1_6] Show the field ONLY if: [time_numb] >=6	Number Correct at Time 6 for [domain_1]	text (integer, Min: 0, Max: 100)
49	[outof_1_6] Show the field ONLY if: [time_numb] >=6	Out of what number at Time 6 for [domain_1]	text (number, Min: 0, Max: 100)

50	[perc_1_7] Show the field ONLY if: [time_numb] >=7	Percent Correct at Time 7 for [domain_1]	text (number, Min: 0, Max: 100)
51	[correct_1_7] Show the field ONLY if: [time_numb] >=7	Number Correct at Time 7 for [domain_1]	text (integer, Min: 0, Max: 100)
52	[outof_1_7] Show the field ONLY if: [time_numb] >=7	Out of what number at Time 7 for [domain_1]	text (number, Min: 0, Max: 100)
53	[perc_1_8] Show the field ONLY if: [time_numb] >=8	Percent Correct at Time 8 for [domain_1]	text (number, Min: 0, Max: 100)
54	[correct_1_8] Show the field ONLY if: [time_numb] >=8	Number Correct at Time 8 for [domain_1]	text (integer, Min: 0, Max: 100)
55	[outof_1_8] Show the field ONLY if: [time_numb] >=8	Out of what number at Time 8 for [domain_1]	text (number, Min: 0, Max: 100)
56	[perc_1_9] Show the field ONLY if: [time_numb] >=9	Percent Correct at Time 9 for [domain_1]	text (number, Min: 0, Max: 100)
57	[correct_1_9] Show the field ONLY if: [time_numb] >=9	Number Correct at Time 9 for [domain_1]	text (integer, Min: 0, Max: 100)
58	[outof_1_9] Show the field ONLY if: [time_numb] >=9	Out of what number at Time 9 for [domain_1]	text (number, Min: 0, Max: 100)
59	[perc_1_10] Show the field ONLY if: [time_numb] >=10	Percent Correct at Time 10 for [domain_1]	text (number, Min: 0, Max: 100)
60	[correct_1_10] Show the field ONLY if: [time_numb] >=10	Number Correct at Time 10 for [domain_1]	text (integer, Min: 0, Max: 100)
61	[outof_1_10] Show the field ONLY if: [time_numb] >=10	Out of what number at Time 10 for [domain_1]	text (number, Min: 0, Max: 100)
62	[perc_1_11] Show the field ONLY if: [time_numb] >=11	Percent Correct at Time 11 for [domain_1]	text (number, Min: 0, Max: 100)
63	[correct_1_11] Show the field ONLY if: [time_numb] >=11	Number Correct at Time 11 for [domain_1]	text (integer, Min: 0, Max: 100)
64	[outof_1_11] Show the field ONLY if: [time_numb] >=11	Out of what number at Time 11 for [domain_1]	text (number, Min: 0, Max: 100)

65	[perc_1_12] Show the field ONLY if: [time_numb] >=12	Percent Correct at Time 12 for [domain_1]	text (number, Min: 0, Max: 100)
66	[correct_1_12] Show the field ONLY if: [time_numb] >=12	Number Correct at Time 12 for [domain_1]	text (integer, Min: 0, Max: 100)

67	[outof_1_12] Show the field ONLY if: [time_numb] >=12	Out of what number at Time 12 for [domain_1]	text (number, Min: 0, Max: 100)
68	[perc_1_13] Show the field ONLY if: [time_numb] >=13	Percent Correct at Time 13 for [domain_1]	text (number, Min: 0, Max: 100)
69	[correct_1_13] Show the field ONLY if: [time_numb] >=13	Number Correct at Time 13 for [domain_1]	text (integer, Min: 0, Max: 100)
70	[outof_1_13] Show the field ONLY if: [time_numb] >=13	Out of what number at Time 13 for [domain_1]	text (number, Min: 0, Max: 100)
71	[perc_1_14] Show the field ONLY if: [time_numb] >=14	Percent Correct at Time 14 for [domain_1]	text (number, Min: 0, Max: 100)
72	[correct_1_14] Show the field ONLY if: [time_numb] >=14	Number Correct at Time 14 for [domain_1]	text (integer, Min: 0, Max: 100)
73	[outof_1_14] Show the field ONLY if: [time_numb] >=14	Out of what number at Time 14 for [domain_1]	text (number, Min: 0, Max: 100)
74	[perc_1_15] Show the field ONLY if: [time_numb] >=15	Percent Correct at Time 15 for [domain_1]	text (number, Min: 0, Max: 100)
75	[correct_1_15] Show the field ONLY if: [time_numb] >=15	Number Correct at Time 15 for [domain_1]	text (integer, Min: 0, Max: 100)
76	[outof_1_15] Show the field ONLY if: [time_numb] >=15	Out of what number at Time 15 for [domain_1]	text (number, Min: 0, Max: 100)
77	[perc_1_16] Show the field ONLY if: [time_numb] >=16	Percent Correct at Time 16 for [domain_1]	text (number, Min: 0, Max: 100)
78	[correct_1_16] Show the field ONLY if: [time_numb] >=16	Number Correct at Time 16 for [domain_1]	text (integer, Min: 0, Max: 100)
79	[outof_1_16] Show the field ONLY if: [time_numb] >=16	Out of what number at Time 16 for [domain_1]	text (number, Min: 0, Max: 100)
80	[perc_1_17] Show the field ONLY if: [time_numb] >=17	Percent Correct at Time 17 for [domain_1]	text (number, Min: 0, Max: 100)
81	[correct_1_17] Show the field ONLY if: [time_numb] >=17	Number Correct at Time 17 for [domain_1]	text (integer, Min: 0, Max: 100)

82	[outof_1_17] Show the field ONLY if: [time_numb] >=17	Out of what number at Time 17 for [domain_1]	text (number, Min: 0, Max: 100)
83	[perc_1_18] Show the field ONLY if: [time_numb] >=18	Percent Correct at Time 18 for [domain_1]	text (number, Min: 0, Max: 100)

84	[correct_1_18] Show the field ONLY if: [time_numb] >=18	Number Correct at Time 18 for [domain_1]	text (integer, Min: 0, Max: 100)
85	[outof_1_18] Show the field ONLY if: [time_numb] >=18	Out of what number at Time 18 for [domain_1]	text (number, Min: 0, Max: 100)
86	[perc_1_19] Show the field ONLY if: [time_numb] >=19	Percent Correct at Time 19 for [domain_1]	text (number, Min: 0, Max: 100)
87	[correct_1_19] Show the field ONLY if: [time_numb] >=19	Number Correct at Time 19 for [domain_1]	text (integer, Min: 0, Max: 100)
88	[outof_1_19] Show the field ONLY if: [time_numb] >=19	Out of what number at Time 19 for [domain_1]	text (number, Min: 0, Max: 100)
89	[perc_1_20] Show the field ONLY if: [time_numb] >=20	Percent Correct at Time 20 for [domain_1]	text (number, Min: 0, Max: 100)
90	[correct_1_20] Show the field ONLY if: [time_numb] >=20	Number Correct at Time 20 for [domain_1]	text (integer, Min: 0, Max: 100)
91	[outof_1_20] Show the field ONLY if: [time_numb] >=20	Out of what number at Time 20 for [domain_1]	text (number, Min: 0, Max: 100)
92	[perc_1_21] Show the field ONLY if: [time_numb] >=21	Percent Correct at Time 21 for [domain_1]	text (number, Min: 0, Max: 100)
93	[correct_1_21] Show the field ONLY if: [time_numb] >=21	Number Correct at Time 21 for [domain_1]	text (integer, Min: 0, Max: 100)
94	[outof_1_21] Show the field ONLY if: [time_numb] >=21	Out of what number at Time 21 for [domain_1]	text (number, Min: 0, Max: 100)
95	[perc_1_22] Show the field ONLY if: [time_numb] >=22	Percent Correct at Time 22 for [domain_1]	text (number, Min: 0, Max: 100)
96	[correct_1_22] Show the field ONLY if: [time_numb] >=22	Number Correct at Time 22 for [domain_1]	text (integer, Min: 0, Max: 100)
97	[outof_1_22] Show the field ONLY if: [time_numb] >=22	Out of what number at Time 22 for [domain_1]	text (number, Min: 0, Max: 100)
98	[perc_1_23] Show the field ONLY if: [time_numb] >=23	Percent Correct at Time 23 for [domain_1]	text (number, Min: 0, Max: 100)

99	[correct_1_23] Show the field ONLY if: [time_numb] >=23	Number Correct at Time 23 for [domain_1]	text (integer, Min: 0, Max: 100)
100	[outof_1_23] Show the field ONLY if: [time_numb] >=23	Out of what number at Time 23 for [domain_1]	text (number, Min: 0, Max: 100)

101	[perc_1_24] Show the field ONLY if: [time_numb] >=24	Percent Correct at Time 24 for [domain_1]	text (number, Min: 0, Max: 100)
102	[correct_1_24] Show the field ONLY if: [time_numb] >=24	Number Correct at Time 24 for [domain_1]	text (integer, Min: 0, Max: 100)
103	[outof_1_24] Show the field ONLY if: [time_numb] >=24	Out of what number at Time 24 for [domain_1]	text (number, Min: 0, Max: 100)
104	[perc_1_25] Show the field ONLY if: [time_numb] >=25	Percent Correct at Time 25 for [domain_1]	text (number, Min: 0, Max: 100)
105	[correct_1_25] Show the field ONLY if: [time_numb] >=25	Number Correct at Time 25 for [domain_1]	text (integer, Min: 0, Max: 100)
106	[outof_1_25] Show the field ONLY if: [time_numb] >=25	Out of what number at Time 25 for [domain_1]	text (number, Min: 0, Max: 100)
107	[perc_1_26] Show the field ONLY if: [time_numb] >=26	Percent Correct at Time 26 for [domain_1]	text (number, Min: 0, Max: 100)
108	[correct_1_26] Show the field ONLY if: [time_numb] >=26	Number Correct at Time 26 for [domain_1]	text (integer, Min: 0, Max: 100)
109	[outof_1_26] Show the field ONLY if: [time_numb] >=26	Out of what number at Time 26 for [domain_1]	text (number, Min: 0, Max: 100)
110	[perc_1_27] Show the field ONLY if: [time_numb] >=27	Percent Correct at Time 27 for [domain_1]	text (number, Min: 0, Max: 100)
111	[correct_1_27] Show the field ONLY if: [time_numb] >=27	Number Correct at Time 27 for [domain_1]	text (integer, Min: 0, Max: 100)
112	[outof_1_27] Show the field ONLY if: [time_numb] >=27	Out of what number at Time 27 for [domain_1]	text (number, Min: 0, Max: 100)
113	[perc_1_28] Show the field ONLY if: [time_numb] >=28	Percent Correct at Time 28 for [domain_1]	text (number, Min: 0, Max: 100)
114	[correct_1_28] Show the field ONLY if: [time_numb] >=28	Number Correct at Time 28 for [domain_1]	text (integer, Min: 0, Max: 100)
115	[outof_1_28] Show the field ONLY if: [time_numb] >=28	Out of what number at Time 28 for [domain_1]	text (number, Min: 0, Max: 100)

116	[perc_1_29] Show the field ONLY if: [time_numb] >=29	Percent Correct at Time 29 for [domain_1]	text (number, Min: 0, Max: 100)
117	[correct_1_29] Show the field ONLY if: [time_numb] >=29	Number Correct at Time 29 for [domain_1]	text (integer, Min: 0, Max: 100)

118	[outof_1_29] Show the field ONLY if: [time_numb] >=29	Out of what number at Time 29 for [domain_1]	text (number, Min: 0, Max: 100)
119	[perc_1_30] Show the field ONLY if: [time_numb] >=30	Percent Correct at Time 30 for [domain_1]	text (number, Min: 0, Max: 100)
120	[correct_1_30] Show the field ONLY if: [time_numb] >=30	Number Correct at Time 30 for [domain_1]	text (integer, Min: 0, Max: 100)
121	[outof_1_30] Show the field ONLY if: [time_numb] >=30	Out of what number at Time 30 for [domain_1]	text (number, Min: 0, Max: 100)
122	[perc_1_31] Show the field ONLY if: [time_numb] >=31	Percent Correct at Time 31 for [domain_1]	text (number, Min: 0, Max: 100)
123	[correct_1_31] Show the field ONLY if: [time_numb] >=31	Number Correct at Time 31 for [domain_1]	text (integer, Min: 0, Max: 100)
124	[outof_1_31] Show the field ONLY if: [time_numb] >=31	Out of what number at Time 31 for [domain_1]	text (number, Min: 0, Max: 100)
125	[perc_1_32] Show the field ONLY if: [time_numb] >=32	Percent Correct at Time 32 for [domain_1]	text (number, Min: 0, Max: 100)
126	[correct_1_32] Show the field ONLY if: [time_numb] >=32	Number Correct at Time 32 for [domain_1]	text (integer, Min: 0, Max: 100)
127	[outof_1_32] Show the field ONLY if: [time_numb] >=32	Out of what number at Time 32 for [domain_1]	text (number, Min: 0, Max: 100)
128	[perc_1_33] Show the field ONLY if: [time_numb] >=33	Percent Correct at Time 33 for [domain_1]	text (number, Min: 0, Max: 100)
129	[correct_1_33] Show the field ONLY if: [time_numb] >=33	Number Correct at Time 33 for [domain_1]	text (integer, Min: 0, Max: 100)
130	[outof_1_33] Show the field ONLY if: [time_numb] >=33	Out of what number at Time 33 for [domain_1]	text (number, Min: 0, Max: 100)
131	[perc_1_34] Show the field ONLY if: [time_numb] >=34	Percent Correct at Time 34 for [domain_1]	text (number, Min: 0, Max: 100)
132	[correct_1_34] Show the field ONLY if: [time_numb] >=34	Number Correct at Time 34 for [domain_1]	text (integer, Min: 0, Max: 100)

133	[outof_1_34] Show the field ONLY if: [time_numb] >=34	Out of what number at Time 34 for [domain_1]	text (number, Min: 0, Max: 100)
134	[perc_1_35] Show the field ONLY if: [time_numb] >=35	Percent Correct at Time 35 for [domain_1]	text (number, Min: 0, Max: 100)

135	[correct_1_35] Show the field ONLY if: [time_numb] >=35	Number Correct at Time 35 for [domain_1]	text (integer, Min: 0, Max: 100)
136	[outof_1_35] Show the field ONLY if: [time_numb] >=35	Out of what number at Time 35 for [domain_1]	text (number, Min: 0, Max: 100)
137	[perc_1_36] Show the field ONLY if: [time_numb] >=36	Percent Correct at Time 36 for [domain_1]	text (number, Min: 0, Max: 100)
138	[correct_1_36] Show the field ONLY if: [time_numb] >=36	Number Correct at Time 36 for [domain_1]	text (integer, Min: 0, Max: 100)
139	[outof_1_36] Show the field ONLY if: [time_numb] >=36	Out of what number at Time 36 for [domain_1]	text (number, Min: 0, Max: 100)
140	[perc_1_37] Show the field ONLY if: [time_numb] >=37	Percent Correct at Time 37 for [domain_1]	text (number, Min: 0, Max: 100)
141	[correct_1_37] Show the field ONLY if: [time_numb] >=37	Number Correct at Time 37 for [domain_1]	text (integer, Min: 0, Max: 100)
142	[outof_1_37] Show the field ONLY if: [time_numb] >=37	Out of what number at Time 37 for [domain_1]	text (number, Min: 0, Max: 100)
143	[perc_1_38] Show the field ONLY if: [time_numb] >=38	Percent Correct at Time 38 for [domain_1]	text (number, Min: 0, Max: 100)
144	[correct_1_38] Show the field ONLY if: [time_numb] >=38	Number Correct at Time 38 for [domain_1]	text (integer, Min: 0, Max: 100)
145	[outof_1_38] Show the field ONLY if: [time_numb] >=38	Out of what number at Time 38 for [domain_1]	text (number, Min: 0, Max: 100)
146	[perc_1_39] Show the field ONLY if: [time_numb] >=39	Percent Correct at Time 39 for [domain_1]	text (number, Min: 0, Max: 100)
147	[correct_1_39] Show the field ONLY if: [time_numb] >=39	Number Correct at Time 39 for [domain_1]	text (integer, Min: 0, Max: 100)
148	[outof_1_39] Show the field ONLY if: [time_numb] >=39	Out of what number at Time 39 for [domain_1]	text (number, Min: 0, Max: 100)
149	[perc_1_40] Show the field ONLY if: [time_numb] >=40	Percent Correct at Time 40 for [domain_1]	text (number, Min: 0, Max: 100)

150	[correct_1_40] Show the field ONLY if: [time_numb] >=40	Number Correct at Time 40 for [domain_1]	text (integer, Min: 0, Max: 100)
151	[outof_1_40] Show the field ONLY if: [time_numb] >=40	Out of what number at Time 40 for [domain_1]	text (number, Min: 0, Max: 100)

152	[perc_1_41] Show the field ONLY if: [time_numb] >=41	Percent Correct at Time 41 for [domain_1]	text (number, Min: 0, Max: 100)
153	[correct_1_41] Show the field ONLY if: [time_numb] >=41	Number Correct at Time 41 for [domain_1]	text (integer, Min: 0, Max: 100)
154	[outof_1_41] Show the field ONLY if: [time_numb] >=41	Out of what number at Time 41 for [domain_1]	text (number, Min: 0, Max: 100)
155	[perc_1_42] Show the field ONLY if: [time_numb] >=42	Percent Correct at Time 42 for [domain_1]	text (number, Min: 0, Max: 100)
156	[correct_1_42] Show the field ONLY if: [time_numb] >=42	Number Correct at Time 42 for [domain_1]	text (integer, Min: 0, Max: 100)
157	[outof_1_42] Show the field ONLY if: [time_numb] >=42	Out of what number at Time 42 for [domain_1]	text (number, Min: 0, Max: 100)
158	[perc_1_43] Show the field ONLY if: [time_numb] >=43	Percent Correct at Time 43 for [domain_1]	text (number, Min: 0, Max: 100)
159	[correct_1_43] Show the field ONLY if: [time_numb] >=43	Number Correct at Time 43 for [domain_1]	text (integer, Min: 0, Max: 100)
160	[outof_1_43] Show the field ONLY if: [time_numb] >=43	Out of what number at Time 43 for [domain_1]	text (number, Min: 0, Max: 100)
161	[perc_1_44] Show the field ONLY if: [time_numb] >=44	Percent Correct at Time 44 for [domain_1]	text (number, Min: 0, Max: 100)
162	[correct_1_44] Show the field ONLY if: [time_numb] >=44	Number Correct at Time 44 for [domain_1]	text (integer, Min: 0, Max: 100)
163	[outof_1_44] Show the field ONLY if: [time_numb] >=44	Out of what number at Time 44 for [domain_1]	text (number, Min: 0, Max: 100)
164	[perc_1_45] Show the field ONLY if: [time_numb] >=45	Percent Correct at Time 45 for [domain_1]	text (number, Min: 0, Max: 100)
165	[correct_1_45] Show the field ONLY if: [time_numb] >=45	Number Correct at Time 45 for [domain_1]	text (integer, Min: 0, Max: 100)
166	[outof_1_45] Show the field ONLY if: [time_numb] >=45	Out of what number at Time 45 for [domain_1]	text (number, Min: 0, Max: 100)

167	[perc_1_46] Show the field ONLY if: [time_numb] >=46	Percent Correct at Time 46 for [domain_1]	text (number, Min: 0, Max: 100)
168	[correct_1_46] Show the field ONLY if: [time_numb] >=46	Number Correct at Time 46 for [domain_1]	text (integer, Min: 0, Max: 100)

169	[outof_1_46] Show the field ONLY if: [time_numb] >=46	Out of what number at Time 46 for [domain_1]	text (number, Min: 0, Max: 100)
170	[perc_1_47] Show the field ONLY if: [time_numb] >=47	Percent Correct at Time 47 for [domain_1]	text (number, Min: 0, Max: 100)
171	[correct_1_47] Show the field ONLY if: [time_numb] >=47	Number Correct at Time 47 for [domain_1]	text (integer, Min: 0, Max: 100)
172	[outof_1_47] Show the field ONLY if: [time_numb] >=47	Out of what number at Time 47 for [domain_1]	text (number, Min: 0, Max: 100)
173	[perc_1_48] Show the field ONLY if: [time_numb] >=48	Percent Correct at Time 48 for [domain_1]	text (number, Min: 0, Max: 100)
174	[correct_1_48] Show the field ONLY if: [time_numb] >=48	Number Correct at Time 48 for [domain_1]	text (integer, Min: 0, Max: 100)
175	[outof_1_48] Show the field ONLY if: [time_numb] >=48	Out of what number at Time 48 for [domain_1]	text (number, Min: 0, Max: 100)
176	[perc_1_49] Show the field ONLY if: [time_numb] >=49	Percent Correct at Time 49 for [domain_1]	text (number, Min: 0, Max: 100)
177	[correct_1_49] Show the field ONLY if: [time_numb] >=49	Number Correct at Time 49 for [domain_1]	text (integer, Min: 0, Max: 100)
178	[outof_1_49] Show the field ONLY if: [time_numb] >=49	Out of what number at Time 49 for [domain_1]	text (number, Min: 0, Max: 100)
179	[perc_1_50] Show the field ONLY if: [time_numb] >=50	Percent Correct at Time 50 for [domain_1]	text (number, Min: 0, Max: 100)
180	[correct_1_50] Show the field ONLY if: [time_numb] >=50	Number Correct at Time 50 for [domain_1]	text (integer, Min: 0, Max: 100)
181	[outof_1_50] Show the field ONLY if: [time_numb] >=50	Out of what number at Time 50 for [domain_1]	text (number, Min: 0, Max: 100)
182	[perc_1_51] Show the field ONLY if: [time_numb] >=51	Percent Correct at Time 51 for [domain_1]	text (number, Min: 0, Max: 100)
183	[correct_1_51] Show the field ONLY if: [time_numb] >=51	Number Correct at Time 51 for [domain_1]	text (integer, Min: 0, Max: 100)

184	[outof_1_51] Show the field ONLY if: [time_numb] >=51	Out of what number at Time 51 for [domain_1]	text (number, Min: 0, Max: 100)
185	[perc_1_52] Show the field ONLY if: [time_numb] >=52	Percent Correct at Time 52 for [domain_1]	text (number, Min: 0, Max: 100)

186	[correct_1_52] Show the field ONLY if: [time_numb] >=52	Number Correct at Time 52 for [domain_1]	text (integer, Min: 0, Max: 100)
187	[outof_1_52] Show the field ONLY if: [time_numb] >=52	Out of what number at Time 52 for [domain_1]	text (number, Min: 0, Max: 100)
188	[perc_1_53] Show the field ONLY if: [time_numb] >=53	Percent Correct at Time 53 for [domain_1]	text (number, Min: 0, Max: 100)
189	[correct_1_53] Show the field ONLY if: [time_numb] >=53	Number Correct at Time 53 for [domain_1]	text (integer, Min: 0, Max: 100)
190	[outof_1_53] Show the field ONLY if: [time_numb] >=53	Out of what number at Time 53 for [domain_1]	text (number, Min: 0, Max: 100)
191	[perc_1_54] Show the field ONLY if: [time_numb] >=54	Percent Correct at Time 54 for [domain_1]	text (number, Min: 0, Max: 100)
192	[correct_1_54] Show the field ONLY if: [time_numb] >=54	Number Correct at Time 54 for [domain_1]	text (integer, Min: 0, Max: 100)
193	[outof_1_54] Show the field ONLY if: [time_numb] >=54	Out of what number at Time 54 for [domain_1]	text (number, Min: 0, Max: 100)
194	[perc_1_55] Show the field ONLY if: [time_numb] >=55	Percent Correct at Time 55 for [domain_1]	text (number, Min: 0, Max: 100)
195	[correct_1_55] Show the field ONLY if: [time_numb] >=55	Number Correct at Time 55 for [domain_1]	text (integer, Min: 0, Max: 100)
196	[outof_1_55] Show the field ONLY if: [time_numb] >=55	Out of what number at Time 55 for [domain_1]	text (number, Min: 0, Max: 100)
197	[perc_1_56] Show the field ONLY if: [time_numb] >=56	Percent Correct at Time 56 for [domain_1]	text (number, Min: 0, Max: 100)
198	[correct_1_56] Show the field ONLY if: [time_numb] >=56	Number Correct at Time 56 for [domain_1]	text (integer, Min: 0, Max: 100)
199	[outof_1_56] Show the field ONLY if: [time_numb] >=56	Out of what number at Time 56 for [domain_1]	text (number, Min: 0, Max: 100)
200	[perc_1_57] Show the field ONLY if: [time_numb] >=57	Percent Correct at Time 57 for [domain_1]	text (number, Min: 0, Max: 100)

201	[correct_1_57] Show the field ONLY if: [time_numb] >=57	Number Correct at Time 57 for [domain_1]	text (integer, Min: 0, Max: 100)
202	[outof_1_57] Show the field ONLY if: [time_numb] >=57	Out of what number at Time 57 for [domain_1]	text (number, Min: 0, Max: 100)

203	[perc_1_58] Show the field ONLY if: [time_numb] >=58	Percent Correct at Time 58 for [domain_1]	text (number, Min: 0, Max: 100)
204	[correct_1_58] Show the field ONLY if: [time_numb] >=58	Number Correct at Time 58 for [domain_1]	text (integer, Min: 0, Max: 100)
205	[outof_1_58] Show the field ONLY if: [time_numb] >=58	Out of what number at Time 58 for [domain_1]	text (number, Min: 0, Max: 100)
206	[perc_1_59] Show the field ONLY if: [time_numb] >=59	Percent Correct at Time 59 for [domain_1]	text (number, Min: 0, Max: 100)
207	[correct_1_59] Show the field ONLY if: [time_numb] >=59	Number Correct at Time 59 for [domain_1]	text (integer, Min: 0, Max: 100)
208	[outof_1_59] Show the field ONLY if: [time_numb] >=59	Out of what number at Time 59 for [domain_1]	text (number, Min: 0, Max: 100)
209	[perc_1_60] Show the field ONLY if: [time_numb] >=60	Percent Correct at Time 60 for [domain_1]	text (number, Min: 0, Max: 100)
210	[correct_1_60] Show the field ONLY if: [time_numb] >=60	Number Correct at Time 60 for [domain_1]	text (integer, Min: 0, Max: 100)
211	[outof_1_60] Show the field ONLY if: [time_numb] >=60	Out of what number at Time 60 for [domain_1]	text (number, Min: 0, Max: 100)
212	[perc_1_61] Show the field ONLY if: [time_numb] >=61	Percent Correct at Time 61 for [domain_1]	text (number, Min: 0, Max: 100)
213	[correct_1_61] Show the field ONLY if: [time_numb] >=61	Number Correct at Time 61 for [domain_1]	text (integer, Min: 0, Max: 100)
214	[outof_1_61] Show the field ONLY if: [time_numb] >=61	Out of what number at Time 61 for [domain_1]	text (number, Min: 0, Max: 100)
215	[perc_1_62] Show the field ONLY if: [time_numb] >=62	Percent Correct at Time 62 for [domain_1]	text (number, Min: 0, Max: 100)
216	[correct_1_62] Show the field ONLY if: [time_numb] >=62	Number Correct at Time 62 for [domain_1]	text (integer, Min: 0, Max: 100)
217	[outof_1_62] Show the field ONLY if: [time_numb] >=62	Out of what number at Time 62 for [domain_1]	text (number, Min: 0, Max: 100)

218	[perc_1_63] Show the field ONLY if: [time_numb] >=63	Percent Correct at Time 63 for [domain_1]	text (number, Min: 0, Max: 100)
219	[correct_1_63] Show the field ONLY if: [time_numb] >=63	Number Correct at Time 63 for [domain_1]	text (integer, Min: 0, Max: 100)

220	[outof_1_63] Show the field ONLY if: [time_numb] >=63	Out of what number at Time 63 for [domain_1]	text (number, Min: 0, Max: 100)
221	[perc_1_64] Show the field ONLY if: [time_numb] >=64	Percent Correct at Time 64 for [domain_1]	text (number, Min: 0, Max: 100)
222	[correct_1_64] Show the field ONLY if: [time_numb] >=64	Number Correct at Time 64 for [domain_1]	text (integer, Min: 0, Max: 100)
223	[outof_1_64] Show the field ONLY if: [time_numb] >=64	Out of what number at Time 64 for [domain_1]	text (number, Min: 0, Max: 100)
224	[perc_1_65] Show the field ONLY if: [time_numb] >=65	Percent Correct at Time 65 for [domain_1]	text (number, Min: 0, Max: 100)
225	[correct_1_65] Show the field ONLY if: [time_numb] >=65	Number Correct at Time 65 for [domain_1]	text (integer, Min: 0, Max: 100)
226	[outof_1_65] Show the field ONLY if: [time_numb] >=65	Out of what number at Time 65 for [domain_1]	text (number, Min: 0, Max: 100)
227	[perc_1_66] Show the field ONLY if: [time_numb] >=66	Percent Correct at Time 66 for [domain_1]	text (number, Min: 0, Max: 100)
228	[correct_1_66] Show the field ONLY if: [time_numb] >=66	Number Correct at Time 66 for [domain_1]	text (integer, Min: 0, Max: 100)
229	[outof_1_66] Show the field ONLY if: [time_numb] >=66	Out of what number at Time 66 for [domain_1]	text (number, Min: 0, Max: 100)
230	[perc_1_67] Show the field ONLY if: [time_numb] >=67	Percent Correct at Time 67 for [domain_1]	text (number, Min: 0, Max: 100)
231	[correct_1_67] Show the field ONLY if: [time_numb] >=67	Number Correct at Time 67 for [domain_1]	text (integer, Min: 0, Max: 100)
232	[outof_1_67] Show the field ONLY if: [time_numb] >=67	Out of what number at Time 67 for [domain_1]	text (number, Min: 0, Max: 100)
233	[perc_1_68] Show the field ONLY if: [time_numb] >=68	Percent Correct at Time 68 for [domain_1]	text (number, Min: 0, Max: 100)
234	[correct_1_68] Show the field ONLY if: [time_numb] >=68	Number Correct at Time 68 for [domain_1]	text (integer, Min: 0, Max: 100)

235	[outof_1_68] Show the field ONLY if: [time_numb] >=68	Out of what number at Time 68 for [domain_1]	text (number, Min: 0, Max: 100)
236	[perc_1_69] Show the field ONLY if: [time_numb] >=69	Percent Correct at Time 69 for [domain_1]	text (number, Min: 0, Max: 100)

237	[correct_1_69] Show the field ONLY if: [time_numb] >=69	Number Correct at Time 69 for [domain_1]	text (integer, Min: 0, Max: 100)
238	[outof_1_69] Show the field ONLY if: [time_numb] >=69	Out of what number at Time 69 for [domain_1]	text (number, Min: 0, Max: 100)
239	[perc_1_70] Show the field ONLY if: [time_numb] >=70	Percent Correct at Time 70 for [domain_1]	text (number, Min: 0, Max: 100)
240	[correct_1_70] Show the field ONLY if: [time_numb] >=70	Number Correct at Time 70 for [domain_1]	text (integer, Min: 0, Max: 100)
241	[outof_1_70] Show the field ONLY if: [time_numb] >=70	Out of what number at Time 70 for [domain_1]	text (number, Min: 0, Max: 100)
242	[perc_1_71] Show the field ONLY if: [time_numb] >=71	Percent Correct at Time 71 for [domain_1]	text (number, Min: 0, Max: 100)
243	[correct_1_71] Show the field ONLY if: [time_numb] >=71	Number Correct at Time 71 for [domain_1]	text (integer, Min: 0, Max: 100)
244	[outof_1_71] Show the field ONLY if: [time_numb] >=71	Out of what number at Time 71 for [domain_1]	text (number, Min: 0, Max: 100)
245	[perc_1_72] Show the field ONLY if: [time_numb] >=72	Percent Correct at Time 72 for [domain_1]	text (number, Min: 0, Max: 100)
246	[correct_1_72] Show the field ONLY if: [time_numb] >=72	Number Correct at Time 72 for [domain_1]	text (integer, Min: 0, Max: 100)
247	[outof_1_72] Show the field ONLY if: [time_numb] >=72	Out of what number at Time 72 for [domain_1]	text (number, Min: 0, Max: 100)
248	[perc_1_73] Show the field ONLY if: [time_numb] >=73	Percent Correct at Time 73 for [domain_1]	text (number, Min: 0, Max: 100)
249	[correct_1_73] Show the field ONLY if: [time_numb] >=73	Number Correct at Time 73 for [domain_1]	text (integer, Min: 0, Max: 100)
250	[outof_1_73] Show the field ONLY if: [time_numb] >=73	Out of what number at Time 73 for [domain_1]	text (number, Min: 0, Max: 100)
251	[perc_1_74] Show the field ONLY if: [time_numb] >=74	Percent Correct at Time 74 for [domain_1]	text (number, Min: 0, Max: 100)

252	[correct_1_74] Show the field ONLY if: [time_numb] >=74	Number Correct at Time 74 for [domain_1]	text (integer, Min: 0, Max: 100)
253	[outof_1_74] Show the field ONLY if: [time_numb] >=74	Out of what number at Time 74 for [domain_1]	text (number, Min: 0, Max: 100)

254	[perc_1_75] Show the field ONLY if: [time_numb] >=75	Percent Correct at Time 75 for [domain_1]	text (number, Min: 0, Max: 100)
255	[correct_1_75] Show the field ONLY if: [time_numb] >=75	Number Correct at Time 75 for [domain_1]	text (integer, Min: 0, Max: 100)
256	[outof_1_75] Show the field ONLY if: [time_numb] >=75	Out of what number at Time 75 for [domain_1]	text (number, Min: 0, Max: 100)
257	[domain_2] Show the field ONLY if: [measure_numb] >= 2	Domain 2 (academic subject)	radio 10 Reading comprehension 20 Reading fluency 30 Math calculation
258	[domain_other_2] Show the field ONLY if: [domain_2] = '80'	If other, please describe:	text
259	[perc_2_1] Show the field ONLY if: [measure_numb] >= 2	Percent Correct at Time 1 for [domain_2]	text (number, Min: 0, Max: 100)
260	[correct_2_1] Show the field ONLY if: [measure_numb] >= 2	Number Correct at Time 1 for [domain_2]	text (integer, Min: 0, Max: 100)
261	[outof_2_1] Show the field ONLY if: [measure_numb] >= 2	Out of what number at Time 1 for [domain_2]	text (number, Min: 0, Max: 100)
262	[perc_2_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 2	Percent Correct at Time 2 for [domain_2]	text (number, Min: 0, Max: 100)
263	[correct_2_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 2	Number Correct at Time 2 for [domain_2]	text (integer, Min: 0, Max: 100)
264	[outof_2_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 2	Out of what number at Time 2 for [domain_2]	text (number, Min: 0, Max: 100)
265	[perc_2_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 2	Percent Correct at Time 3 for [domain_2]	text (number, Min: 0, Max: 100)

266	[correct_2_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 2	Number Correct at Time 3 for [domain_2]	text (integer, Min: 0, Max: 100)
267	[outof_2_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 2	Out of what number at Time 3 for [domain_2]	text (number, Min: 0, Max: 100)

268	[perc_2_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 2	Percent Correct at Time 4 for [domain_2]	text (number, Min: 0, Max: 100)
269	[correct_2_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 2	Number Correct at Time 4 for [domain_2]	text (integer, Min: 0, Max: 100)
270	[outof_2_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 2	Out of what number at Time 4 for [domain_2]	text (number, Min: 0, Max: 100)
271	[perc_2_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 2	Percent Correct at Time 5 for [domain_2]	text (number, Min: 0, Max: 100)
272	[correct_2_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 2	Number Correct at Time 5 for [domain_2]	text (integer, Min: 0, Max: 100)
273	[outof_2_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 2	Out of what number at Time 5 for [domain_2]	text (number, Min: 0, Max: 100)
274	[perc_2_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 2	Percent Correct at Time 6 for [domain_2]	text (number, Min: 0, Max: 100)
275	[correct_2_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 2	Number Correct at Time 6 for [domain_2]	text (integer, Min: 0, Max: 100)
276	[outof_2_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 2	Out of what number at Time 6 for [domain_2]	text (number, Min: 0, Max: 100)
277	[perc_2_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 2	Percent Correct at Time 7 for [domain_2]	text (number, Min: 0, Max: 100)
278	[correct_2_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 2	Number Correct at Time 7 for [domain_2]	text (integer, Min: 0, Max: 100)
279	[outof_2_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 2	Out of what number at Time 7 for [domain_2]	text (number, Min: 0, Max: 100)

280	[perc_2_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 2	Percent Correct at Time 8 for [domain_2]	text (number, Min: 0, Max: 100)
281	[correct_2_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 2	Number Correct at Time 8 for [domain_2]	text (integer, Min: 0, Max: 100)

282	[outof_2_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 2	Out of what number at Time 8 for [domain_2]	text (number, Min: 0, Max: 100)
283	[perc_2_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 2	Percent Correct at Time 9 for [domain_2]	text (number, Min: 0, Max: 100)
284	[correct_2_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 2	Number Correct at Time 9 for [domain_2]	text (integer, Min: 0, Max: 100)
285	[outof_2_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 2	Out of what number at Time 9 for [domain_2]	text (number, Min: 0, Max: 100)
286	[perc_2_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 2	Percent Correct at Time 10 for [domain_2]	text (number, Min: 0, Max: 100)
287	[correct_2_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 2	Number Correct at Time 10 for [domain_2]	text (integer, Min: 0, Max: 100)
288	[outof_2_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 2	Out of what number at Time 10 for [domain_2]	text (number, Min: 0, Max: 100)
289	[perc_2_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 2	Percent Correct at Time 11 for [domain_2]	text (number, Min: 0, Max: 100)
290	[correct_2_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 2	Number Correct at Time 11 for [domain_2]	text (integer, Min: 0, Max: 100)
291	[outof_2_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 2	Out of what number at Time 11 for [domain_2]	text (number, Min: 0, Max: 100)
292	[perc_2_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 2	Percent Correct at Time 12 for [domain_2]	text (number, Min: 0, Max: 100)
293	[correct_2_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 2	Number Correct at Time 12 for [domain_2]	text (integer, Min: 0, Max: 100)

294	[outof_2_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 2	Out of what number at Time 12 for [domain_2]	text (number, Min: 0, Max: 100)
295	[perc_2_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 2	Percent Correct at Time 13 for [domain_2]	text (number, Min: 0, Max: 100)

296	[correct_2_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 2	Number Correct at Time 13 for [domain_2]	text (integer, Min: 0, Max: 100)
297	[outof_2_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 2	Out of what number at Time 13 for [domain_2]	text (number, Min: 0, Max: 100)
298	[perc_2_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 2	Percent Correct at Time 14 for [domain_2]	text (number, Min: 0, Max: 100)
299	[correct_2_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 2	Number Correct at Time 14 for [domain_2]	text (integer, Min: 0, Max: 100)
300	[outof_2_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 2	Out of what number at Time 14 for [domain_2]	text (number, Min: 0, Max: 100)
301	[perc_2_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 2	Percent Correct at Time 15 for [domain_2]	text (number, Min: 0, Max: 100)
302	[correct_2_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 2	Number Correct at Time 15 for [domain_2]	text (integer, Min: 0, Max: 100)
303	[outof_2_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 2	Out of what number at Time 15 for [domain_2]	text (number, Min: 0, Max: 100)
304	[perc_2_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 2	Percent Correct at Time 16 for [domain_2]	text (number, Min: 0, Max: 100)
305	[correct_2_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 2	Number Correct at Time 16 for [domain_2]	text (integer, Min: 0, Max: 100)
306	[outof_2_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 2	Out of what number at Time 16 for [domain_2]	text (number, Min: 0, Max: 100)
307	[perc_2_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 2	Percent Correct at Time 17 for [domain_2]	text (number, Min: 0, Max: 100)

308	[correct_2_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 2	Number Correct at Time 17 for [domain_2]	text (integer, Min: 0, Max: 100)
309	[outof_2_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 2	Out of what number at Time 17 for [domain_2]	text (number, Min: 0, Max: 100)

310	[perc_2_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 2	Percent Correct at Time 18 for [domain_2]	text (number, Min: 0, Max: 100)
311	[correct_2_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 2	Number Correct at Time 18 for [domain_2]	text (integer, Min: 0, Max: 100)
312	[outof_2_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 2	Out of what number at Time 18 for [domain_2]	text (number, Min: 0, Max: 100)
313	[perc_2_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 2	Percent Correct at Time 19 for [domain_2]	text (number, Min: 0, Max: 100)
314	[correct_2_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 2	Number Correct at Time 19 for [domain_2]	text (integer, Min: 0, Max: 100)
315	[outof_2_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 2	Out of what number at Time 19 for [domain_2]	text (number, Min: 0, Max: 100)
316	[perc_2_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 2	Percent Correct at Time 20 for [domain_2]	text (number, Min: 0, Max: 100)
317	[correct_2_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 2	Number Correct at Time 20 for [domain_2]	text (integer, Min: 0, Max: 100)
318	[outof_2_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 2	Out of what number at Time 20 for [domain_2]	text (number, Min: 0, Max: 100)
319	[perc_2_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 2	Percent Correct at Time 21 for [domain_2]	text (number, Min: 0, Max: 100)
320	[correct_2_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 2	Number Correct at Time 21 for [domain_2]	text (integer, Min: 0, Max: 100)
321	[outof_2_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 2	Out of what number at Time 21 for [domain_2]	text (number, Min: 0, Max: 100)

322	[perc_2_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 2	Percent Correct at Time 22 for [domain_2]	text (number, Min: 0, Max: 100)
323	[correct_2_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 2	Number Correct at Time 22 for [domain_2]	text (integer, Min: 0, Max: 100)

324	[outof_2_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 2	Out of what number at Time 22 for [domain_2]	text (number, Min: 0, Max: 100)
325	[perc_2_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 2	Percent Correct at Time 23 for [domain_2]	text (number, Min: 0, Max: 100)
326	[correct_2_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 2	Number Correct at Time 23 for [domain_2]	text (integer, Min: 0, Max: 100)
327	[outof_2_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 2	Out of what number at Time 23 for [domain_2]	text (number, Min: 0, Max: 100)
328	[perc_2_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 2	Percent Correct at Time 24 for [domain_2]	text (number, Min: 0, Max: 100)
329	[correct_2_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 2	Number Correct at Time 24 for [domain_2]	text (integer, Min: 0, Max: 100)
330	[outof_2_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 2	Out of what number at Time 24 for [domain_2]	text (number, Min: 0, Max: 100)
331	[perc_2_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 2	Percent Correct at Time 25 for [domain_2]	text (number, Min: 0, Max: 100)
332	[correct_2_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 2	Number Correct at Time 25 for [domain_2]	text (integer, Min: 0, Max: 100)
333	[outof_2_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 2	Out of what number at Time 25 for [domain_2]	text (number, Min: 0, Max: 100)
334	[perc_2_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 2	Percent Correct at Time 26 for [domain_2]	text (number, Min: 0, Max: 100)
335	[correct_2_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 2	Number Correct at Time 26 for [domain_2]	text (integer, Min: 0, Max: 100)

336	[outof_2_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 2	Out of what number at Time 26 for [domain_2]	text (number, Min: 0, Max: 100)
337	[perc_2_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 2	Percent Correct at Time 27 for [domain_2]	text (number, Min: 0, Max: 100)

338	[correct_2_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 2	Number Correct at Time 27 for [domain_2]	text (integer, Min: 0, Max: 100)
339	[outof_2_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 2	Out of what number at Time 27 for [domain_2]	text (number, Min: 0, Max: 100)
340	[perc_2_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 2	Percent Correct at Time 28 for [domain_2]	text (number, Min: 0, Max: 100)
341	[correct_2_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 2	Number Correct at Time 28 for [domain_2]	text (integer, Min: 0, Max: 100)
342	[outof_2_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 2	Out of what number at Time 28 for [domain_2]	text (number, Min: 0, Max: 100)
343	[perc_2_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 2	Percent Correct at Time 29 for [domain_2]	text (number, Min: 0, Max: 100)
344	[correct_2_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 2	Number Correct at Time 29 for [domain_2]	text (integer, Min: 0, Max: 100)
345	[outof_2_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 2	Out of what number at Time 29 for [domain_2]	text (number, Min: 0, Max: 100)
346	[perc_2_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 2	Percent Correct at Time 30 for [domain_2]	text (number, Min: 0, Max: 100)
347	[correct_2_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 2	Number Correct at Time 30 for [domain_2]	text (integer, Min: 0, Max: 100)
348	[outof_2_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 2	Out of what number at Time 30 for [domain_2]	text (number, Min: 0, Max: 100)
349	[perc_2_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 2	Percent Correct at Time 31 for [domain_2]	text (number, Min: 0, Max: 100)

350	[correct_2_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 2	Number Correct at Time 31 for [domain_2]	text (integer, Min: 0, Max: 100)
351	[outof_2_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 2	Out of what number at Time 31 for [domain_2]	text (number, Min: 0, Max: 100)

352	[perc_2_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 2	Percent Correct at Time 32 for [domain_2]	text (number, Min: 0, Max: 100)
353	[correct_2_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 2	Number Correct at Time 32 for [domain_2]	text (integer, Min: 0, Max: 100)
354	[outof_2_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 2	Out of what number at Time 32 for [domain_2]	text (number, Min: 0, Max: 100)
355	[perc_2_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 2	Percent Correct at Time 33 for [domain_2]	text (number, Min: 0, Max: 100)
356	[correct_2_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 2	Number Correct at Time 33 for [domain_2]	text (integer, Min: 0, Max: 100)
357	[outof_2_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 2	Out of what number at Time 33 for [domain_2]	text (number, Min: 0, Max: 100)
358	[perc_2_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 2	Percent Correct at Time 34 for [domain_2]	text (number, Min: 0, Max: 100)
359	[correct_2_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 2	Number Correct at Time 34 for [domain_2]	text (integer, Min: 0, Max: 100)
360	[outof_2_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 2	Out of what number at Time 34 for [domain_2]	text (number, Min: 0, Max: 100)
361	[perc_2_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 2	Percent Correct at Time 35 for [domain_2]	text (number, Min: 0, Max: 100)
362	[correct_2_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 2	Number Correct at Time 35 for [domain_2]	text (integer, Min: 0, Max: 100)
363	[outof_2_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 2	Out of what number at Time 35 for [domain_2]	text (number, Min: 0, Max: 100)

364	[perc_2_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 2	Percent Correct at Time 36 for [domain_2]	text (number, Min: 0, Max: 100)
365	[correct_2_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 2	Number Correct at Time 36 for [domain_2]	text (integer, Min: 0, Max: 100)

366	[outof_2_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 2	Out of what number at Time 36 for [domain_2]	text (number, Min: 0, Max: 100)
367	[perc_2_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 2	Percent Correct at Time 37 for [domain_2]	text (number, Min: 0, Max: 100)
368	[correct_2_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 2	Number Correct at Time 37 for [domain_2]	text (integer, Min: 0, Max: 100)
369	[outof_2_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 2	Out of what number at Time 37 for [domain_2]	text (number, Min: 0, Max: 100)
370	[perc_2_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 2	Percent Correct at Time 38 for [domain_2]	text (number, Min: 0, Max: 100)
371	[correct_2_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 2	Number Correct at Time 38 for [domain_2]	text (integer, Min: 0, Max: 100)
372	[outof_2_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 2	Out of what number at Time 38 for [domain_2]	text (number, Min: 0, Max: 100)
373	[perc_2_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 2	Percent Correct at Time 39 for [domain_2]	text (number, Min: 0, Max: 100)
374	[correct_2_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 2	Number Correct at Time 39 for [domain_2]	text (integer, Min: 0, Max: 100)
375	[outof_2_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 2	Out of what number at Time 39 for [domain_2]	text (number, Min: 0, Max: 100)
376	[perc_2_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 2	Percent Correct at Time 40 for [domain_2]	text (number, Min: 0, Max: 100)
377	[correct_2_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 2	Number Correct at Time 40 for [domain_2]	text (integer, Min: 0, Max: 100)

378	[outof_2_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 2	Out of what number at Time 40 for [domain_2]	text (number, Min: 0, Max: 100)
379	[perc_2_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 2	Percent Correct at Time 41 for [domain_2]	text (number, Min: 0, Max: 100)

380	[correct_2_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 2	Number Correct at Time 41 for [domain_2]	text (integer, Min: 0, Max: 100)
381	[outof_2_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 2	Out of what number at Time 41 for [domain_2]	text (number, Min: 0, Max: 100)
382	[perc_2_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 2	Percent Correct at Time 42 for [domain_2]	text (number, Min: 0, Max: 100)
383	[correct_2_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 2	Number Correct at Time 42 for [domain_2]	text (integer, Min: 0, Max: 100)
384	[outof_2_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 2	Out of what number at Time 42 for [domain_2]	text (number, Min: 0, Max: 100)
385	[perc_2_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 2	Percent Correct at Time 43 for [domain_2]	text (number, Min: 0, Max: 100)
386	[correct_2_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 2	Number Correct at Time 43 for [domain_2]	text (integer, Min: 0, Max: 100)
387	[outof_2_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 2	Out of what number at Time 43 for [domain_2]	text (number, Min: 0, Max: 100)
388	[perc_2_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 2	Percent Correct at Time 44 for [domain_2]	text (number, Min: 0, Max: 100)
389	[correct_2_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 2	Number Correct at Time 44 for [domain_2]	text (integer, Min: 0, Max: 100)
390	[outof_2_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 2	Out of what number at Time 44 for [domain_2]	text (number, Min: 0, Max: 100)
391	[perc_2_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 2	Percent Correct at Time 45 for [domain_2]	text (number, Min: 0, Max: 100)

392	[correct_2_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 2	Number Correct at Time 45 for [domain_2]	text (integer, Min: 0, Max: 100)
393	[outof_2_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 2	Out of what number at Time 45 for [domain_2]	text (number, Min: 0, Max: 100)

394	[perc_2_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 2	Percent Correct at Time 46 for [domain_2]	text (number, Min: 0, Max: 100)
395	[correct_2_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 2	Number Correct at Time 46 for [domain_2]	text (integer, Min: 0, Max: 100)
396	[outof_2_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 2	Out of what number at Time 46 for [domain_2]	text (number, Min: 0, Max: 100)
397	[perc_2_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 2	Percent Correct at Time 47 for [domain_2]	text (number, Min: 0, Max: 100)
398	[correct_2_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 2	Number Correct at Time 47 for [domain_2]	text (integer, Min: 0, Max: 100)
399	[outof_2_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 2	Out of what number at Time 47 for [domain_2]	text (number, Min: 0, Max: 100)
400	[perc_2_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 2	Percent Correct at Time 48 for [domain_2]	text (number, Min: 0, Max: 100)
401	[correct_2_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 2	Number Correct at Time 48 for [domain_2]	text (integer, Min: 0, Max: 100)
402	[outof_2_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 2	Out of what number at Time 48 for [domain_2]	text (number, Min: 0, Max: 100)
403	[perc_2_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 2	Percent Correct at Time 49 for [domain_2]	text (number, Min: 0, Max: 100)
404	[correct_2_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 2	Number Correct at Time 49 for [domain_2]	text (integer, Min: 0, Max: 100)
405	[outof_2_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 2	Out of what number at Time 49 for [domain_2]	text (number, Min: 0, Max: 100)

406	[perc_2_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 2	Percent Correct at Time 50 for [domain_2]	text (number, Min: 0, Max: 100)
407	[correct_2_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 2	Number Correct at Time 50 for [domain_2]	text (integer, Min: 0, Max: 100)

408	[outof_2_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 2	Out of what number at Time 50 for [domain_2]	text (number, Min: 0, Max: 100)
409	[perc_2_51] Show the field ONLY if: [time_numb] >=51 and [measure_numb] >= 2	Percent Correct at Time 51 for [domain_2]	text (number, Min: 0, Max: 100)
410	[correct_2_51] Show the field ONLY if: [time_numb] >=51 and [measure_numb] >= 2	Number Correct at Time 51 for [domain_2]	text (integer, Min: 0, Max: 100)
411	[outof_2_51] Show the field ONLY if: [time_numb] >=51 and [measure_numb] >= 2	Out of what number at Time 51 for [domain_2]	text (number, Min: 0, Max: 100)
412	[perc_2_52] Show the field ONLY if: [time_numb] >=52 and [measure_numb] >= 2	Percent Correct at Time 52 for [domain_2]	text (number, Min: 0, Max: 100)
413	[correct_2_52] Show the field ONLY if: [time_numb] >=52 and [measure_numb] >= 2	Number Correct at Time 52 for [domain_2]	text (integer, Min: 0, Max: 100)
414	[outof_2_52] Show the field ONLY if: [time_numb] >=52 and [measure_numb] >= 2	Out of what number at Time 52 for [domain_2]	text (number, Min: 0, Max: 100)
415	[perc_2_53] Show the field ONLY if: [time_numb] >=53 and [measure_numb] >= 2	Percent Correct at Time 53 for [domain_2]	text (number, Min: 0, Max: 100)
416	[correct_2_53] Show the field ONLY if: [time_numb] >=53 and [measure_numb] >= 2	Number Correct at Time 53 for [domain_2]	text (integer, Min: 0, Max: 100)
417	[outof_2_53] Show the field ONLY if: [time_numb] >=53 and [measure_numb] >= 2	Out of what number at Time 53 for [domain_2]	text (number, Min: 0, Max: 100)
418	[perc_2_54] Show the field ONLY if: [time_numb] >=54 and [measure_numb] >= 2	Percent Correct at Time 54 for [domain_2]	text (number, Min: 0, Max: 100)
419	[correct_2_54] Show the field ONLY if: [time_numb] >=54 and [measure_numb] >= 2	Number Correct at Time 54 for [domain_2]	text (integer, Min: 0, Max: 100)

420	[outof_2_54] Show the field ONLY if: [time_numb] >=54 and [measure_numb] >= 2	Out of what number at Time 54 for [domain_2]	text (number, Min: 0, Max: 100)
421	[perc_2_55] Show the field ONLY if: [time_numb] >=55 and [measure_numb] >= 2	Percent Correct at Time 55 for [domain_2]	text (number, Min: 0, Max: 100)

422	[correct_2_55] Show the field ONLY if: [time_numb] >=55 and [measure_numb] >= 2	Number Correct at Time 55 for [domain_2]	text (integer, Min: 0, Max: 100)
423	[outof_2_55] Show the field ONLY if: [time_numb] >=55 and [measure_numb] >= 2	Out of what number at Time 55 for [domain_2]	text (number, Min: 0, Max: 100)
424	[perc_2_56] Show the field ONLY if: [time_numb] >=56 and [measure_numb] >= 2	Percent Correct at Time 56 for [domain_2]	text (number, Min: 0, Max: 100)
425	[correct_2_56] Show the field ONLY if: [time_numb] >=56 and [measure_numb] >= 2	Number Correct at Time 56 for [domain_2]	text (integer, Min: 0, Max: 100)
426	[outof_2_56] Show the field ONLY if: [time_numb] >=56 and [measure_numb] >= 2	Out of what number at Time 56 for [domain_2]	text (number, Min: 0, Max: 100)
427	[perc_2_57] Show the field ONLY if: [time_numb] >=57 and [measure_numb] >= 2	Percent Correct at Time 57 for [domain_2]	text (number, Min: 0, Max: 100)
428	[correct_2_57] Show the field ONLY if: [time_numb] >=57 and [measure_numb] >= 2	Number Correct at Time 57 for [domain_2]	text (integer, Min: 0, Max: 100)
429	[outof_2_57] Show the field ONLY if: [time_numb] >=57 and [measure_numb] >= 2	Out of what number at Time 57 for [domain_2]	text (number, Min: 0, Max: 100)
430	[perc_2_58] Show the field ONLY if: [time_numb] >=58 and [measure_numb] >= 2	Percent Correct at Time 58 for [domain_2]	text (number, Min: 0, Max: 100)
431	[correct_2_58] Show the field ONLY if: [time_numb] >=58 and [measure_numb] >= 2	Number Correct at Time 58 for [domain_2]	text (integer, Min: 0, Max: 100)
432	[outof_2_58] Show the field ONLY if: [time_numb] >=58 and [measure_numb] >= 2	Out of what number at Time 58 for [domain_2]	text (number, Min: 0, Max: 100)
433	[perc_2_59] Show the field ONLY if: [time_numb] >=59 and [measure_numb] >= 2	Percent Correct at Time 59 for [domain_2]	text (number, Min: 0, Max: 100)

434	[correct_2_59] Show the field ONLY if: [time_numb] >=59 and [measure_numb] >= 2	Number Correct at Time 59 for [domain_2]	text (integer, Min: 0, Max: 100)
435	[outof_2_59] Show the field ONLY if: [time_numb] >=59 and [measure_numb] >= 2	Out of what number at Time 59 for [domain_2]	text (number, Min: 0, Max: 100)

436	[perc_2_60] Show the field ONLY if: [time_numb] >=60 and [measure_numb] >= 2	Percent Correct at Time 60 for [domain_2]	text (number, Min: 0, Max: 100)
437	[correct_2_60] Show the field ONLY if: [time_numb] >=60 and [measure_numb] >= 2	Number Correct at Time 60 for [domain_2]	text (integer, Min: 0, Max: 100)
438	[outof_2_60] Show the field ONLY if: [time_numb] >=60 and [measure_numb] >= 2	Out of what number at Time 60 for [domain_2]	text (number, Min: 0, Max: 100)
439	[perc_2_61] Show the field ONLY if: [time_numb] >=61 and [measure_numb] >= 2	Percent Correct at Time 61 for [domain_2]	text (number, Min: 0, Max: 100)
440	[correct_2_61] Show the field ONLY if: [time_numb] >=61 and [measure_numb] >= 2	Number Correct at Time 61 for [domain_2]	text (integer, Min: 0, Max: 100)
441	[outof_2_61] Show the field ONLY if: [time_numb] >=61 and [measure_numb] >= 2	Out of what number at Time 61 for [domain_2]	text (number, Min: 0, Max: 100)
442	[perc_2_62] Show the field ONLY if: [time_numb] >=62 and [measure_numb] >= 2	Percent Correct at Time 62 for [domain_2]	text (number, Min: 0, Max: 100)
443	[correct_2_62] Show the field ONLY if: [time_numb] >=62 and [measure_numb] >= 2	Number Correct at Time 62 for [domain_2]	text (integer, Min: 0, Max: 100)
444	[outof_2_62] Show the field ONLY if: [time_numb] >=62 and [measure_numb] >= 2	Out of what number at Time 62 for [domain_2]	text (number, Min: 0, Max: 100)
445	[perc_2_63] Show the field ONLY if: [time_numb] >=63 and [measure_numb] >= 2	Percent Correct at Time 63 for [domain_2]	text (number, Min: 0, Max: 100)
446	[correct_2_63] Show the field ONLY if: [time_numb] >=63 and [measure_numb] >= 2	Number Correct at Time 63 for [domain_2]	text (integer, Min: 0, Max: 100)
447	[outof_2_63] Show the field ONLY if: [time_numb] >=63 and [measure_numb] >= 2	Out of what number at Time 63 for [domain_2]	text (number, Min: 0, Max: 100)

448	[perc_2_64] Show the field ONLY if: [time_numb] >=64 and [measure_numb] >= 2	Percent Correct at Time 64 for [domain_2]	text (number, Min: 0, Max: 100)
449	[correct_2_64] Show the field ONLY if: [time_numb] >=64 and [measure_numb] >= 2	Number Correct at Time 64 for [domain_2]	text (integer, Min: 0, Max: 100)

450	[outof_2_64] Show the field ONLY if: [time_numb] >=64 and [measure_numb] >= 2	Out of what number at Time 64 for [domain_2]	text (number, Min: 0, Max: 100)
451	[perc_2_65] Show the field ONLY if: [time_numb] >=65 and [measure_numb] >= 2	Percent Correct at Time 65 for [domain_2]	text (number, Min: 0, Max: 100)
452	[correct_2_65] Show the field ONLY if: [time_numb] >=65 and [measure_numb] >= 2	Number Correct at Time 65 for [domain_2]	text (integer, Min: 0, Max: 100)
453	[outof_2_65] Show the field ONLY if: [time_numb] >=65 and [measure_numb] >= 2	Out of what number at Time 65 for [domain_2]	text (number, Min: 0, Max: 100)
454	[perc_2_66] Show the field ONLY if: [time_numb] >=66 and [measure_numb] >= 2	Percent Correct at Time 66 for [domain_2]	text (number, Min: 0, Max: 100)
455	[correct_2_66] Show the field ONLY if: [time_numb] >=66 and [measure_numb] >= 2	Number Correct at Time 66 for [domain_2]	text (integer, Min: 0, Max: 100)
456	[outof_2_66] Show the field ONLY if: [time_numb] >=66 and [measure_numb] >= 2	Out of what number at Time 66 for [domain_2]	text (number, Min: 0, Max: 100)
457	[perc_2_67] Show the field ONLY if: [time_numb] >=67 and [measure_numb] >= 2	Percent Correct at Time 67 for [domain_2]	text (number, Min: 0, Max: 100)
458	[correct_2_67] Show the field ONLY if: [time_numb] >=67 and [measure_numb] >= 2	Number Correct at Time 67 for [domain_2]	text (integer, Min: 0, Max: 100)
459	[outof_2_67] Show the field ONLY if: [time_numb] >=67 and [measure_numb] >= 2	Out of what number at Time 67 for [domain_2]	text (number, Min: 0, Max: 100)
460	[perc_2_68] Show the field ONLY if: [time_numb] >=68 and [measure_numb] >= 2	Percent Correct at Time 68 for [domain_2]	text (number, Min: 0, Max: 100)
461	[correct_2_68] Show the field ONLY if: [time_numb] >=68 and [measure_numb] >= 2	Number Correct at Time 68 for [domain_2]	text (integer, Min: 0, Max: 100)

462	[outof_2_68] Show the field ONLY if: [time_numb] >=68 and [measure_numb] >= 2	Out of what number at Time 68 for [domain_2]	text (number, Min: 0, Max: 100)
463	[perc_2_69] Show the field ONLY if: [time_numb] >=69 and [measure_numb] >= 2	Percent Correct at Time 69 for [domain_2]	text (number, Min: 0, Max: 100)

464	[correct_2_69] Show the field ONLY if: [time_numb] >=69 and [measure_numb] >= 2	Number Correct at Time 69 for [domain_2]	text (integer, Min: 0, Max: 100)
465	[outof_2_69] Show the field ONLY if: [time_numb] >=69 and [measure_numb] >= 2	Out of what number at Time 69 for [domain_2]	text (number, Min: 0, Max: 100)
466	[perc_2_70] Show the field ONLY if: [time_numb] >=70 and [measure_numb] >= 2	Percent Correct at Time 70 for [domain_2]	text (number, Min: 0, Max: 100)
467	[correct_2_70] Show the field ONLY if: [time_numb] >=70 and [measure_numb] >= 2	Number Correct at Time 70 for [domain_2]	text (integer, Min: 0, Max: 100)
468	[outof_2_70] Show the field ONLY if: [time_numb] >=70 and [measure_numb] >= 2	Out of what number at Time 70 for [domain_2]	text (number, Min: 0, Max: 100)
469	[perc_2_71] Show the field ONLY if: [time_numb] >=71 and [measure_numb] >= 2	Percent Correct at Time 71 for [domain_2]	text (number, Min: 0, Max: 100)
470	[correct_2_71] Show the field ONLY if: [time_numb] >=71 and [measure_numb] >= 2	Number Correct at Time 71 for [domain_2]	text (integer, Min: 0, Max: 100)
471	[outof_2_71] Show the field ONLY if: [time_numb] >=71 and [measure_numb] >= 2	Out of what number at Time 71 for [domain_2]	text (number, Min: 0, Max: 100)
472	[perc_2_72] Show the field ONLY if: [time_numb] >=72 and [measure_numb] >= 2	Percent Correct at Time 72 for [domain_2]	text (number, Min: 0, Max: 100)
473	[correct_2_72] Show the field ONLY if: [time_numb] >=72 and [measure_numb] >= 2	Number Correct at Time 72 for [domain_2]	text (integer, Min: 0, Max: 100)
474	[outof_2_72] Show the field ONLY if: [time_numb] >=72 and [measure_numb] >= 2	Out of what number at Time 72 for [domain_2]	text (number, Min: 0, Max: 100)
475	[perc_2_73] Show the field ONLY if: [time_numb] >=73 and [measure_numb] >= 2	Percent Correct at Time 73 for [domain_2]	text (number, Min: 0, Max: 100)

476	[correct_2_73] Show the field ONLY if: [time_numb] >=73 and [measure_numb] >= 2	Number Correct at Time 73 for [domain_2]	text (integer, Min: 0, Max: 100)
477	[outof_2_73] Show the field ONLY if: [time_numb] >=73 and [measure_numb] >= 2	Out of what number at Time 73 for [domain_2]	text (number, Min: 0, Max: 100)

478	[perc_2_74] Show the field ONLY if: [time_numb] >=74 and [measure_numb] >= 2	Percent Correct at Time 74 for [domain_2]	text (number, Min: 0, Max: 100)
479	[correct_2_74] Show the field ONLY if: [time_numb] >=74 and [measure_numb] >= 2	Number Correct at Time 74 for [domain_2]	text (integer, Min: 0, Max: 100)
480	[outof_2_74] Show the field ONLY if: [time_numb] >=74 and [measure_numb] >= 2	Out of what number at Time 74 for [domain_2]	text (number, Min: 0, Max: 100)
481	[perc_2_75] Show the field ONLY if: [time_numb] >=75 and [measure_numb] >= 2	Percent Correct at Time 75 for [domain_2]	text (number, Min: 0, Max: 100)
482	[correct_2_75] Show the field ONLY if: [time_numb] >=75 and [measure_numb] >= 2	Number Correct at Time 75 for [domain_2]	text (integer, Min: 0, Max: 100)
483	[outof_2_75] Show the field ONLY if: [time_numb] >=75 and [measure_numb] >= 2	Out of what number at Time 75 for [domain_2]	text (number, Min: 0, Max: 100)
484	[domain_3] Show the field ONLY if: [measure_numb] >= 3	Domain 3 (academic subject)	radio 10 Reading comprehension 20 Reading fluency 30 Math calculation
485	[domain_other_3] Show the field ONLY if: [domain_3] = '80'	If other, please describe:	text
486	[perc_3_1] Show the field ONLY if: [measure_numb] >= 3	Percent Correct at Time 1 for [domain_3]	text (number, Min: 0, Max: 100)
487	[correct_3_1] Show the field ONLY if: [measure_numb] >= 3	Number Correct at Time 1 for [domain_3]	text (integer, Min: 0, Max: 100)
488	[outof_3_1] Show the field ONLY if: [measure_numb] >= 3	Out of what number at Time 1 for [domain_3]	text (number, Min: 0, Max: 100)

489	[perc_3_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 3	Percent Correct at Time 2 for [domain_3]	text (number, Min: 0, Max: 100)
490	[correct_3_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 3	Number Correct at Time 2 for [domain_3]	text (integer, Min: 0, Max: 100)

491	[outof_3_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 3	Out of what number at Time 2 for [domain_3]	text (number, Min: 0, Max: 100)
492	[perc_3_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 3	Percent Correct at Time 3 for [domain_3]	text (number, Min: 0, Max: 100)
493	[correct_3_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 3	Number Correct at Time 3 for [domain_3]	text (integer, Min: 0, Max: 100)
494	[outof_3_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 3	Out of what number at Time 3 for [domain_3]	text (number, Min: 0, Max: 100)
495	[perc_3_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 3	Percent Correct at Time 4 for [domain_3]	text (number, Min: 0, Max: 100)
496	[correct_3_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 3	Number Correct at Time 4 for [domain_3]	text (integer, Min: 0, Max: 100)
497	[outof_3_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 3	Out of what number at Time 4 for [domain_3]	text (number, Min: 0, Max: 100)
498	[perc_3_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 3	Percent Correct at Time 5 for [domain_3]	text (number, Min: 0, Max: 100)
499	[correct_3_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 3	Number Correct at Time 5 for [domain_3]	text (integer, Min: 0, Max: 100)
500	[outof_3_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 3	Out of what number at Time 5 for [domain_3]	text (number, Min: 0, Max: 100)
501	[perc_3_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 3	Percent Correct at Time 6 for [domain_3]	text (number, Min: 0, Max: 100)
502	[correct_3_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 3	Number Correct at Time 6 for [domain_3]	text (integer, Min: 0, Max: 100)

503	[outof_3_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 3	Out of what number at Time 6 for [domain_3]	text (number, Min: 0, Max: 100)
504	[perc_3_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 3	Percent Correct at Time 7 for [domain_3]	text (number, Min: 0, Max: 100)

505	[correct_3_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 3	Number Correct at Time 7 for [domain_3]	text (integer, Min: 0, Max: 100)
506	[outof_3_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 3	Out of what number at Time 7 for [domain_3]	text (number, Min: 0, Max: 100)
507	[perc_3_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 3	Percent Correct at Time 8 for [domain_3]	text (number, Min: 0, Max: 100)
508	[correct_3_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 3	Number Correct at Time 8 for [domain_3]	text (integer, Min: 0, Max: 100)
509	[outof_3_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 3	Out of what number at Time 8 for [domain_3]	text (number, Min: 0, Max: 100)
510	[perc_3_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 3	Percent Correct at Time 9 for [domain_3]	text (number, Min: 0, Max: 100)
511	[correct_3_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 3	Number Correct at Time 9 for [domain_3]	text (integer, Min: 0, Max: 100)
512	[outof_3_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 3	Out of what number at Time 9 for [domain_3]	text (number, Min: 0, Max: 100)
513	[perc_3_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 3	Percent Correct at Time 10 for [domain_3]	text (number, Min: 0, Max: 100)
514	[correct_3_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 3	Number Correct at Time 10 for [domain_3]	text (integer, Min: 0, Max: 100)
515	[outof_3_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 3	Out of what number at Time 10 for [domain_3]	text (number, Min: 0, Max: 100)
516	[perc_3_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 3	Percent Correct at Time 11 for [domain_3]	text (number, Min: 0, Max: 100)

517	[correct_3_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 3	Number Correct at Time 11 for [domain_3]	text (integer, Min: 0, Max: 100)
518	[outof_3_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 3	Out of what number at Time 11 for [domain_3]	text (number, Min: 0, Max: 100)

519	[perc_3_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 3	Percent Correct at Time 12 for [domain_3]	text (number, Min: 0, Max: 100)
520	[correct_3_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 3	Number Correct at Time 12 for [domain_3]	text (integer, Min: 0, Max: 100)
521	[outof_3_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 3	Out of what number at Time 12 for [domain_3]	text (number, Min: 0, Max: 100)
522	[perc_3_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 3	Percent Correct at Time 13 for [domain_3]	text (number, Min: 0, Max: 100)
523	[correct_3_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 3	Number Correct at Time 13 for [domain_3]	text (integer, Min: 0, Max: 100)
524	[outof_3_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 3	Out of what number at Time 13 for [domain_3]	text (number, Min: 0, Max: 100)
525	[perc_3_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 3	Percent Correct at Time 14 for [domain_3]	text (number, Min: 0, Max: 100)
526	[correct_3_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 3	Number Correct at Time 14 for [domain_3]	text (integer, Min: 0, Max: 100)
527	[outof_3_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 3	Out of what number at Time 14 for [domain_3]	text (number, Min: 0, Max: 100)
528	[perc_3_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 3	Percent Correct at Time 15 for [domain_3]	text (number, Min: 0, Max: 100)
529	[correct_3_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 3	Number Correct at Time 15 for [domain_3]	text (integer, Min: 0, Max: 100)
530	[outof_3_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 3	Out of what number at Time 15 for [domain_3]	text (number, Min: 0, Max: 100)

531	[perc_3_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 3	Percent Correct at Time 16 for [domain_3]	text (number, Min: 0, Max: 100)
532	[correct_3_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 3	Number Correct at Time 16 for [domain_3]	text (integer, Min: 0, Max: 100)

533	[outof_3_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 3	Out of what number at Time 16 for [domain_3]	text (number, Min: 0, Max: 100)
534	[perc_3_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 3	Percent Correct at Time 17 for [domain_3]	text (number, Min: 0, Max: 100)
535	[correct_3_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 3	Number Correct at Time 17 for [domain_3]	text (integer, Min: 0, Max: 100)
536	[outof_3_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 3	Out of what number at Time 17 for [domain_3]	text (number, Min: 0, Max: 100)
537	[perc_3_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 3	Percent Correct at Time 18 for [domain_3]	text (number, Min: 0, Max: 100)
538	[correct_3_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 3	Number Correct at Time 18 for [domain_3]	text (integer, Min: 0, Max: 100)
539	[outof_3_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 3	Out of what number at Time 18 for [domain_3]	text (number, Min: 0, Max: 100)
540	[perc_3_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 3	Percent Correct at Time 19 for [domain_3]	text (number, Min: 0, Max: 100)
541	[correct_3_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 3	Number Correct at Time 19 for [domain_3]	text (integer, Min: 0, Max: 100)
542	[outof_3_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 3	Out of what number at Time 19 for [domain_3]	text (number, Min: 0, Max: 100)
543	[perc_3_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 3	Percent Correct at Time 20 for [domain_3]	text (number, Min: 0, Max: 100)
544	[correct_3_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 3	Number Correct at Time 20 for [domain_3]	text (integer, Min: 0, Max: 100)

545	[outof_3_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 3	Out of what number at Time 20 for [domain_3]	text (number, Min: 0, Max: 100)
546	[perc_3_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 3	Percent Correct at Time 21 for [domain_3]	text (number, Min: 0, Max: 100)

547	[correct_3_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 3	Number Correct at Time 21 for [domain_3]	text (integer, Min: 0, Max: 100)
548	[outof_3_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 3	Out of what number at Time 21 for [domain_3]	text (number, Min: 0, Max: 100)
549	[perc_3_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 3	Percent Correct at Time 22 for [domain_3]	text (number, Min: 0, Max: 100)
550	[correct_3_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 3	Number Correct at Time 22 for [domain_3]	text (integer, Min: 0, Max: 100)
551	[outof_3_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 3	Out of what number at Time 22 for [domain_3]	text (number, Min: 0, Max: 100)
552	[perc_3_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 3	Percent Correct at Time 23 for [domain_3]	text (number, Min: 0, Max: 100)
553	[correct_3_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 3	Number Correct at Time 23 for [domain_3]	text (integer, Min: 0, Max: 100)
554	[outof_3_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 3	Out of what number at Time 23 for [domain_3]	text (number, Min: 0, Max: 100)
555	[perc_3_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 3	Percent Correct at Time 24 for [domain_3]	text (number, Min: 0, Max: 100)
556	[correct_3_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 3	Number Correct at Time 24 for [domain_3]	text (integer, Min: 0, Max: 100)
557	[outof_3_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 3	Out of what number at Time 24 for [domain_3]	text (number, Min: 0, Max: 100)
558	[perc_3_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 3	Percent Correct at Time 25 for [domain_3]	text (number, Min: 0, Max: 100)

559	[correct_3_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 3	Number Correct at Time 25 for [domain_3]	text (integer, Min: 0, Max: 100)
560	[outof_3_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 3	Out of what number at Time 25 for [domain_3]	text (number, Min: 0, Max: 100)

561	[perc_3_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 3	Percent Correct at Time 26 for [domain_3]	text (number, Min: 0, Max: 100)
562	[correct_3_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 3	Number Correct at Time 26 for [domain_3]	text (integer, Min: 0, Max: 100)
563	[outof_3_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 3	Out of what number at Time 26 for [domain_3]	text (number, Min: 0, Max: 100)
564	[perc_3_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 3	Percent Correct at Time 27 for [domain_3]	text (number, Min: 0, Max: 100)
565	[correct_3_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 3	Number Correct at Time 27 for [domain_3]	text (integer, Min: 0, Max: 100)
566	[outof_3_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 3	Out of what number at Time 27 for [domain_3]	text (number, Min: 0, Max: 100)
567	[perc_3_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 3	Percent Correct at Time 28 for [domain_3]	text (number, Min: 0, Max: 100)
568	[correct_3_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 3	Number Correct at Time 28 for [domain_3]	text (integer, Min: 0, Max: 100)
569	[outof_3_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 3	Out of what number at Time 28 for [domain_3]	text (number, Min: 0, Max: 100)
570	[perc_3_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 3	Percent Correct at Time 29 for [domain_3]	text (number, Min: 0, Max: 100)
571	[correct_3_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 3	Number Correct at Time 29 for [domain_3]	text (integer, Min: 0, Max: 100)
572	[outof_3_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 3	Out of what number at Time 29 for [domain_3]	text (number, Min: 0, Max: 100)

573	[perc_3_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 3	Percent Correct at Time 30 for [domain_3]	text (number, Min: 0, Max: 100)
574	[correct_3_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 3	Number Correct at Time 30 for [domain_3]	text (integer, Min: 0, Max: 100)

575	[outof_3_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 3	Out of what number at Time 30 for [domain_3]	text (number, Min: 0, Max: 100)
576	[perc_3_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 3	Percent Correct at Time 31 for [domain_3]	text (number, Min: 0, Max: 100)
577	[correct_3_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 3	Number Correct at Time 31 for [domain_3]	text (integer, Min: 0, Max: 100)
578	[outof_3_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 3	Out of what number at Time 31 for [domain_3]	text (number, Min: 0, Max: 100)
579	[perc_3_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 3	Percent Correct at Time 32 for [domain_3]	text (number, Min: 0, Max: 100)
580	[correct_3_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 3	Number Correct at Time 32 for [domain_3]	text (integer, Min: 0, Max: 100)
581	[outof_3_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 3	Out of what number at Time 32 for [domain_3]	text (number, Min: 0, Max: 100)
582	[perc_3_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 3	Percent Correct at Time 33 for [domain_3]	text (number, Min: 0, Max: 100)
583	[correct_3_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 3	Number Correct at Time 33 for [domain_3]	text (integer, Min: 0, Max: 100)
584	[outof_3_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 3	Out of what number at Time 33 for [domain_3]	text (number, Min: 0, Max: 100)
585	[perc_3_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 3	Percent Correct at Time 34 for [domain_3]	text (number, Min: 0, Max: 100)
586	[correct_3_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 3	Number Correct at Time 34 for [domain_3]	text (integer, Min: 0, Max: 100)

587	[outof_3_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 3	Out of what number at Time 34 for [domain_3]	text (number, Min: 0, Max: 100)
588	[perc_3_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 3	Percent Correct at Time 35 for [domain_3]	text (number, Min: 0, Max: 100)

589	[correct_3_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 3	Number Correct at Time 35 for [domain_3]	text (integer, Min: 0, Max: 100)
590	[outof_3_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 3	Out of what number at Time 35 for [domain_3]	text (number, Min: 0, Max: 100)
591	[perc_3_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 3	Percent Correct at Time 36 for [domain_3]	text (number, Min: 0, Max: 100)
592	[correct_3_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 3	Number Correct at Time 36 for [domain_3]	text (integer, Min: 0, Max: 100)
593	[outof_3_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 3	Out of what number at Time 36 for [domain_3]	text (number, Min: 0, Max: 100)
594	[perc_3_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 3	Percent Correct at Time 37 for [domain_3]	text (number, Min: 0, Max: 100)
595	[correct_3_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 3	Number Correct at Time 37 for [domain_3]	text (integer, Min: 0, Max: 100)
596	[outof_3_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 3	Out of what number at Time 37 for [domain_3]	text (number, Min: 0, Max: 100)
597	[perc_3_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 3	Percent Correct at Time 38 for [domain_3]	text (number, Min: 0, Max: 100)
598	[correct_3_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 3	Number Correct at Time 38 for [domain_3]	text (integer, Min: 0, Max: 100)
599	[outof_3_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 3	Out of what number at Time 38 for [domain_3]	text (number, Min: 0, Max: 100)
600	[perc_3_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 3	Percent Correct at Time 39 for [domain_3]	text (number, Min: 0, Max: 100)

601	[correct_3_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 3	Number Correct at Time 39 for [domain_3]	text (integer, Min: 0, Max: 100)
602	[outof_3_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 3	Out of what number at Time 39 for [domain_3]	text (number, Min: 0, Max: 100)

603	[perc_3_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 3	Percent Correct at Time 40 for [domain_3]	text (number, Min: 0, Max: 100)
604	[correct_3_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 3	Number Correct at Time 40 for [domain_3]	text (integer, Min: 0, Max: 100)
605	[outof_3_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 3	Out of what number at Time 40 for [domain_3]	text (number, Min: 0, Max: 100)
606	[perc_3_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 3	Percent Correct at Time 41 for [domain_3]	text (number, Min: 0, Max: 100)
607	[correct_3_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 3	Number Correct at Time 41 for [domain_3]	text (integer, Min: 0, Max: 100)
608	[outof_3_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 3	Out of what number at Time 41 for [domain_3]	text (number, Min: 0, Max: 100)
609	[perc_3_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 3	Percent Correct at Time 42 for [domain_3]	text (number, Min: 0, Max: 100)
610	[correct_3_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 3	Number Correct at Time 42 for [domain_3]	text (integer, Min: 0, Max: 100)
611	[outof_3_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 3	Out of what number at Time 42 for [domain_3]	text (number, Min: 0, Max: 100)
612	[perc_3_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 3	Percent Correct at Time 43 for [domain_3]	text (number, Min: 0, Max: 100)
613	[correct_3_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 3	Number Correct at Time 43 for [domain_3]	text (integer, Min: 0, Max: 100)
614	[outof_3_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 3	Out of what number at Time 43 for [domain_3]	text (number, Min: 0, Max: 100)

615	[perc_3_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 3	Percent Correct at Time 44 for [domain_3]	text (number, Min: 0, Max: 100)
616	[correct_3_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 3	Number Correct at Time 44 for [domain_3]	text (integer, Min: 0, Max: 100)

617	[outof_3_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 3	Out of what number at Time 44 for [domain_3]	text (number, Min: 0, Max: 100)
618	[perc_3_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 3	Percent Correct at Time 45 for [domain_3]	text (number, Min: 0, Max: 100)
619	[correct_3_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 3	Number Correct at Time 45 for [domain_3]	text (integer, Min: 0, Max: 100)
620	[outof_3_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 3	Out of what number at Time 45 for [domain_3]	text (number, Min: 0, Max: 100)
621	[perc_3_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 3	Percent Correct at Time 46 for [domain_3]	text (number, Min: 0, Max: 100)
622	[correct_3_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 3	Number Correct at Time 46 for [domain_3]	text (integer, Min: 0, Max: 100)
623	[outof_3_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 3	Out of what number at Time 46 for [domain_3]	text (number, Min: 0, Max: 100)
624	[perc_3_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 3	Percent Correct at Time 47 for [domain_3]	text (number, Min: 0, Max: 100)
625	[correct_3_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 3	Number Correct at Time 47 for [domain_3]	text (integer, Min: 0, Max: 100)
626	[outof_3_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 3	Out of what number at Time 47 for [domain_3]	text (number, Min: 0, Max: 100)
627	[perc_3_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 3	Percent Correct at Time 48 for [domain_3]	text (number, Min: 0, Max: 100)
628	[correct_3_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 3	Number Correct at Time 48 for [domain_3]	text (integer, Min: 0, Max: 100)

629	[outof_3_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 3	Out of what number at Time 48 for [domain_3]	text (number, Min: 0, Max: 100)
630	[perc_3_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 3	Percent Correct at Time 49 for [domain_3]	text (number, Min: 0, Max: 100)

631	[correct_3_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 3	Number Correct at Time 49 for [domain_3]	text (integer, Min: 0, Max: 100)
632	[outof_3_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 3	Out of what number at Time 49 for [domain_3]	text (number, Min: 0, Max: 100)
633	[perc_3_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 3	Percent Correct at Time 50 for [domain_3]	text (number, Min: 0, Max: 100)
634	[correct_3_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 3	Number Correct at Time 50 for [domain_3]	text (integer, Min: 0, Max: 100)
635	[outof_3_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 3	Out of what number at Time 50 for [domain_3]	text (number, Min: 0, Max: 100)
636	[perc_3_51] Show the field ONLY if: [time_numb] >=51 and [measure_numb] >= 3	Percent Correct at Time 51 for [domain_3]	text (number, Min: 0, Max: 100)
637	[correct_3_51] Show the field ONLY if: [time_numb] >=51 and [measure_numb] >= 3	Number Correct at Time 51 for [domain_3]	text (integer, Min: 0, Max: 100)
638	[outof_3_51] Show the field ONLY if: [time_numb] >=51 and [measure_numb] >= 3	Out of what number at Time 51 for [domain_3]	text (number, Min: 0, Max: 100)
639	[perc_3_52] Show the field ONLY if: [time_numb] >=52 and [measure_numb] >= 3	Percent Correct at Time 52 for [domain_3]	text (number, Min: 0, Max: 100)
640	[correct_3_52] Show the field ONLY if: [time_numb] >=52 and [measure_numb] >= 3	Number Correct at Time 52 for [domain_3]	text (integer, Min: 0, Max: 100)
641	[outof_3_52] Show the field ONLY if: [time_numb] >=52 and [measure_numb] >= 3	Out of what number at Time 52 for [domain_3]	text (number, Min: 0, Max: 100)
642	[perc_3_53] Show the field ONLY if: [time_numb] >=53 and [measure_numb] >= 3	Percent Correct at Time 53 for [domain_3]	text (number, Min: 0, Max: 100)

643	[correct_3_53] Show the field ONLY if: [time_numb] >=53 and [measure_numb] >= 3	Number Correct at Time 53 for [domain_3]	text (integer, Min: 0, Max: 100)
644	[outof_3_53] Show the field ONLY if: [time_numb] >=53 and [measure_numb] >= 3	Out of what number at Time 53 for [domain_3]	text (number, Min: 0, Max: 100)

645	[perc_3_54] Show the field ONLY if: [time_numb] >=54 and [measure_numb] >= 3	Percent Correct at Time 54 for [domain_3]	text (number, Min: 0, Max: 100)
646	[correct_3_54] Show the field ONLY if: [time_numb] >=54 and [measure_numb] >= 3	Number Correct at Time 54 for [domain_3]	text (integer, Min: 0, Max: 100)
647	[outof_3_54] Show the field ONLY if: [time_numb] >=54 and [measure_numb] >= 3	Out of what number at Time 4 for [domain_3]	text (number, Min: 0, Max: 100)
648	[perc_3_55] Show the field ONLY if: [time_numb] >=55 and [measure_numb] >= 3	Percent Correct at Time 55 for [domain_3]	text (number, Min: 0, Max: 100)
649	[correct_3_55] Show the field ONLY if: [time_numb] >=55 and [measure_numb] >= 3	Number Correct at Time 55 for [domain_3]	text (integer, Min: 0, Max: 100)
650	[outof_3_55] Show the field ONLY if: [time_numb] >=55 and [measure_numb] >= 3	Out of what number at Time 55 for [domain_3]	text (number, Min: 0, Max: 100)
651	[domain_4] Show the field ONLY if: [measure_numb] >= 4	Domain 4 (academic subject)	radio 10 Reading comprehension 20 Reading fluency 30 Math calculation
652	[domain_other_4] Show the field ONLY if: [domain_4] = '80'	If other, please describe:	text
653	[perc_4_1] Show the field ONLY if: [measure_numb] >= 4	Percent Correct at Time 1 for [domain_4]	text (number, Min: 0, Max: 100)
654	[correct_4_1] Show the field ONLY if: [measure_numb] >= 4	Number Correct at Time 1 for [domain_4]	text (integer, Min: 0, Max: 100)
655	[outof_4_1] Show the field ONLY if: [measure_numb] >= 4	Out of what number at Time 1 for [domain_4]	text (number, Min: 0, Max: 100)

656	[perc_4_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 4	Percent Correct at Time 2 for [domain_4]	text (number, Min: 0, Max: 100)
657	[correct_4_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 4	Number Correct at Time 2 for [domain_4]	text (integer, Min: 0, Max: 100)

658	[outof_4_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 4	Out of what number at Time 2 for [domain_4]	text (number, Min: 0, Max: 100)
659	[perc_4_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 4	Percent Correct at Time 3 for [domain_4]	text (number, Min: 0, Max: 100)
660	[correct_4_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 4	Number Correct at Time 3 for [domain_4]	text (integer, Min: 0, Max: 100)
661	[outof_4_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 4	Out of what number at Time 3 for [domain_4]	text (number, Min: 0, Max: 100)
662	[perc_4_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 4	Percent Correct at Time 4 for [domain_4]	text (number, Min: 0, Max: 100)
663	[correct_4_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 4	Number Correct at Time 4 for [domain_4]	text (integer, Min: 0, Max: 100)
664	[outof_4_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 4	Out of what number at Time 4 for [domain_4]	text (number, Min: 0, Max: 100)
665	[perc_4_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 4	Percent Correct at Time 5 for [domain_4]	text (number, Min: 0, Max: 100)
666	[correct_4_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 4	Number Correct at Time 5 for [domain_4]	text (integer, Min: 0, Max: 100)
667	[outof_4_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 4	Out of what number at Time 5 for [domain_4]	text (number, Min: 0, Max: 100)
668	[perc_4_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 4	Percent Correct at Time 6 for [domain_4]	text (number, Min: 0, Max: 100)
669	[correct_4_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 4	Number Correct at Time 6 for [domain_4]	text (integer, Min: 0, Max: 100)

670	[outof_4_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 4	Out of what number at Time 6 for [domain_4]	text (number, Min: 0, Max: 100)
671	[perc_4_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 4	Percent Correct at Time 7 for [domain_4]	text (number, Min: 0, Max: 100)

672	[correct_4_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 4	Number Correct at Time 7 for [domain_4]	text (integer, Min: 0, Max: 100)
673	[outof_4_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 4	Out of what number at Time 7 for [domain_4]	text (number, Min: 0, Max: 100)
674	[perc_4_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 4	Percent Correct at Time 8 for [domain_4]	text (number, Min: 0, Max: 100)
675	[correct_4_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 4	Number Correct at Time 8 for [domain_4]	text (integer, Min: 0, Max: 100)
676	[outof_4_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 4	Out of what number at Time 8 for [domain_4]	text (number, Min: 0, Max: 100)
677	[perc_4_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 4	Percent Correct at Time 9 for [domain_4]	text (number, Min: 0, Max: 100)
678	[correct_4_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 4	Number Correct at Time 9 for [domain_4]	text (integer, Min: 0, Max: 100)
679	[outof_4_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 4	Out of what number at Time 9 for [domain_4]	text (number, Min: 0, Max: 100)
680	[perc_4_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 4	Percent Correct at Time 10 for [domain_4]	text (number, Min: 0, Max: 100)
681	[correct_4_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 4	Number Correct at Time 10 for [domain_4]	text (integer, Min: 0, Max: 100)
682	[outof_4_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 4	Out of what number at Time 10 for [domain_4]	text (number, Min: 0, Max: 100)
683	[perc_4_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 4	Percent Correct at Time 11 for [domain_4]	text (number, Min: 0, Max: 100)

684	[correct_4_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 4	Number Correct at Time 11 for [domain_4]	text (integer, Min: 0, Max: 100)
685	[outof_4_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 4	Out of what number at Time 11 for [domain_4]	text (number, Min: 0, Max: 100)

686	[perc_4_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 4	Percent Correct at Time 12 for [domain_4]	text (number, Min: 0, Max: 100)
687	[correct_4_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 4	Number Correct at Time 12 for [domain_4]	text (integer, Min: 0, Max: 100)
688	[outof_4_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 4	Out of what number at Time 12 for [domain_4]	text (number, Min: 0, Max: 100)
689	[perc_4_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 4	Percent Correct at Time 13 for [domain_4]	text (number, Min: 0, Max: 100)
690	[correct_4_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 4	Number Correct at Time 13 for [domain_4]	text (integer, Min: 0, Max: 100)
691	[outof_4_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 4	Out of what number at Time 13 for [domain_4]	text (number, Min: 0, Max: 100)
692	[perc_4_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 4	Percent Correct at Time 14 for [domain_4]	text (number, Min: 0, Max: 100)
693	[correct_4_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 4	Number Correct at Time 14 for [domain_4]	text (integer, Min: 0, Max: 100)
694	[outof_4_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 4	Out of what number at Time 14 for [domain_4]	text (number, Min: 0, Max: 100)
695	[perc_4_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 4	Percent Correct at Time 15 for [domain_4]	text (number, Min: 0, Max: 100)
696	[correct_4_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 4	Number Correct at Time 15 for [domain_4]	text (integer, Min: 0, Max: 100)
697	[outof_4_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 4	Out of what number at Time 15 for [domain_4]	text (number, Min: 0, Max: 100)

698	[perc_4_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 4	Percent Correct at Time 16 for [domain_4]	text (number, Min: 0, Max: 100)
699	[correct_4_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 4	Number Correct at Time 16 for [domain_4]	text (integer, Min: 0, Max: 100)

700	[outof_4_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 4	Out of what number at Time 16 for [domain_4]	text (number, Min: 0, Max: 100)
701	[perc_4_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 4	Percent Correct at Time 17 for [domain_4]	text (number, Min: 0, Max: 100)
702	[correct_4_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 4	Number Correct at Time 17 for [domain_4]	text (integer, Min: 0, Max: 100)
703	[outof_4_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 4	Out of what number at Time 17 for [domain_4]	text (number, Min: 0, Max: 100)
704	[perc_4_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 4	Percent Correct at Time 18 for [domain_4]	text (number, Min: 0, Max: 100)
705	[correct_4_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 4	Number Correct at Time 18 for [domain_4]	text (integer, Min: 0, Max: 100)
706	[outof_4_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 4	Out of what number at Time 18 for [domain_4]	text (number, Min: 0, Max: 100)
707	[perc_4_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 4	Percent Correct at Time 19 for [domain_4]	text (number, Min: 0, Max: 100)
708	[correct_4_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 4	Number Correct at Time 19 for [domain_4]	text (integer, Min: 0, Max: 100)
709	[outof_4_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 4	Out of what number at Time 19 for [domain_4]	text (number, Min: 0, Max: 100)
710	[perc_4_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 4	Percent Correct at Time 20 for [domain_4]	text (number, Min: 0, Max: 100)
711	[correct_4_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 4	Number Correct at Time 20 for [domain_4]	text (integer, Min: 0, Max: 100)

712	[outof_4_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 4	Out of what number at Time 20 for [domain_4]	text (number, Min: 0, Max: 100)
713	[perc_4_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 4	Percent Correct at Time 21 for [domain_4]	text (number, Min: 0, Max: 100)

714	[correct_4_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 4	Number Correct at Time 21 for [domain_4]	text (integer, Min: 0, Max: 100)
715	[outof_4_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 4	Out of what number at Time 21 for [domain_4]	text (number, Min: 0, Max: 100)
716	[perc_4_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 4	Percent Correct at Time 22 for [domain_4]	text (number, Min: 0, Max: 100)
717	[correct_4_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 4	Number Correct at Time 22 for [domain_4]	text (integer, Min: 0, Max: 100)
718	[outof_4_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 4	Out of what number at Time 22 for [domain_4]	text (number, Min: 0, Max: 100)
719	[perc_4_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 4	Percent Correct at Time 23 for [domain_4]	text (number, Min: 0, Max: 100)
720	[correct_4_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 4	Number Correct at Time 23 for [domain_4]	text (integer, Min: 0, Max: 100)
721	[outof_4_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 4	Out of what number at Time 23 for [domain_4]	text (number, Min: 0, Max: 100)
722	[perc_4_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 4	Percent Correct at Time 24 for [domain_4]	text (number, Min: 0, Max: 100)
723	[correct_4_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 4	Number Correct at Time 24 for [domain_4]	text (integer, Min: 0, Max: 100)
724	[outof_4_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 4	Out of what number at Time 24 for [domain_4]	text (number, Min: 0, Max: 100)
725	[perc_4_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 4	Percent Correct at Time 25 for [domain_4]	text (number, Min: 0, Max: 100)

726	[correct_4_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 4	Number Correct at Time 25 for [domain_4]	text (integer, Min: 0, Max: 100)
727	[outof_4_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 4	Out of what number at Time 25 for [domain_4]	text (number, Min: 0, Max: 100)

728	[perc_4_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 4	Percent Correct at Time 26 for [domain_4]	text (number, Min: 0, Max: 100)
729	[correct_4_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 4	Number Correct at Time 26 for [domain_4]	text (integer, Min: 0, Max: 100)
730	[outof_4_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 4	Out of what number at Time 26 for [domain_4]	text (number, Min: 0, Max: 100)
731	[perc_4_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 4	Percent Correct at Time 27 for [domain_4]	text (number, Min: 0, Max: 100)
732	[correct_4_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 4	Number Correct at Time 27 for [domain_4]	text (integer, Min: 0, Max: 100)
733	[outof_4_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 4	Out of what number at Time 27 for [domain_4]	text (number, Min: 0, Max: 100)
734	[perc_4_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 4	Percent Correct at Time 28 for [domain_4]	text (number, Min: 0, Max: 100)
735	[correct_4_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 4	Number Correct at Time 28 for [domain_4]	text (integer, Min: 0, Max: 100)
736	[outof_4_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 4	Out of what number at Time 28 for [domain_4]	text (number, Min: 0, Max: 100)
737	[perc_4_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 4	Percent Correct at Time 29 for [domain_4]	text (number, Min: 0, Max: 100)
738	[correct_4_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 4	Number Correct at Time 29 for [domain_4]	text (integer, Min: 0, Max: 100)
739	[outof_4_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 4	Out of what number at Time 29 for [domain_4]	text (number, Min: 0, Max: 100)

740	[perc_4_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 4	Percent Correct at Time 30 for [domain_4]	text (number, Min: 0, Max: 100)
741	[correct_4_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 4	Number Correct at Time 30 for [domain_4]	text (integer, Min: 0, Max: 100)

742	[outof_4_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 4	Out of what number at Time 30 for [domain_4]	text (number, Min: 0, Max: 100)
743	[perc_4_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 4	Percent Correct at Time 31 for [domain_4]	text (number, Min: 0, Max: 100)
744	[correct_4_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 4	Number Correct at Time 31 for [domain_4]	text (integer, Min: 0, Max: 100)
745	[outof_4_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 4	Out of what number at Time 31 for [domain_4]	text (number, Min: 0, Max: 100)
746	[perc_4_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 4	Percent Correct at Time 32 for [domain_4]	text (number, Min: 0, Max: 100)
747	[correct_4_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 4	Number Correct at Time 32 for [domain_4]	text (integer, Min: 0, Max: 100)
748	[outof_4_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 4	Out of what number at Time 32 for [domain_4]	text (number, Min: 0, Max: 100)
749	[perc_4_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 4	Percent Correct at Time 33 for [domain_4]	text (number, Min: 0, Max: 100)
750	[correct_4_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 4	Number Correct at Time 33 for [domain_4]	text (integer, Min: 0, Max: 100)
751	[outof_4_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 4	Out of what number at Time 33 for [domain_4]	text (number, Min: 0, Max: 100)
752	[perc_4_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 4	Percent Correct at Time 34 for [domain_4]	text (number, Min: 0, Max: 100)
753	[correct_4_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 4	Number Correct at Time 34 for [domain_4]	text (integer, Min: 0, Max: 100)

754	[outof_4_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 4	Out of what number at Time 34 for [domain_4]	text (number, Min: 0, Max: 100)
755	[perc_4_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 4	Percent Correct at Time 35 for [domain_4]	text (number, Min: 0, Max: 100)

756	[correct_4_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 4	Number Correct at Time 35 for [domain_4]	text (integer, Min: 0, Max: 100)
757	[outof_4_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 4	Out of what number at Time 35 for [domain_4]	text (number, Min: 0, Max: 100)
758	[perc_4_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 4	Percent Correct at Time 36 for [domain_4]	text (number, Min: 0, Max: 100)
759	[correct_4_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 4	Number Correct at Time 36 for [domain_4]	text (integer, Min: 0, Max: 100)
760	[outof_4_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 4	Out of what number at Time 36 for [domain_4]	text (number, Min: 0, Max: 100)
761	[perc_4_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 4	Percent Correct at Time 37 for [domain_4]	text (number, Min: 0, Max: 100)
762	[correct_4_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 4	Number Correct at Time 37 for [domain_4]	text (integer, Min: 0, Max: 100)
763	[outof_4_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 4	Out of what number at Time 37 for [domain_4]	text (number, Min: 0, Max: 100)
764	[perc_4_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 4	Percent Correct at Time 38 for [domain_4]	text (number, Min: 0, Max: 100)
765	[correct_4_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 4	Number Correct at Time 38 for [domain_4]	text (integer, Min: 0, Max: 100)
766	[outof_4_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 4	Out of what number at Time 38 for [domain_4]	text (number, Min: 0, Max: 100)
767	[perc_4_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 4	Percent Correct at Time 39 for [domain_4]	text (number, Min: 0, Max: 100)

768	[correct_4_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 4	Number Correct at Time 39 for [domain_4]	text (integer, Min: 0, Max: 100)
769	[outof_4_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 4	Out of what number at Time 39 for [domain_4]	text (number, Min: 0, Max: 100)

770	[perc_4_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 4	Percent Correct at Time 40 for [domain_4]	text (number, Min: 0, Max: 100)
771	[correct_4_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 4	Number Correct at Time 40 for [domain_4]	text (integer, Min: 0, Max: 100)
772	[outof_4_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 4	Out of what number at Time 40 for [domain_4]	text (number, Min: 0, Max: 100)
773	[perc_4_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 4	Percent Correct at Time 41 for [domain_4]	text (number, Min: 0, Max: 100)
774	[correct_4_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 4	Number Correct at Time 41 for [domain_4]	text (integer, Min: 0, Max: 100)
775	[outof_4_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 4	Out of what number at Time 41 for [domain_4]	text (number, Min: 0, Max: 100)
776	[perc_4_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 4	Percent Correct at Time 42 for [domain_4]	text (number, Min: 0, Max: 100)
777	[correct_4_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 4	Number Correct at Time 42 for [domain_4]	text (integer, Min: 0, Max: 100)
778	[outof_4_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 4	Out of what number at Time 42 for [domain_4]	text (number, Min: 0, Max: 100)
779	[perc_4_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 4	Percent Correct at Time 43 for [domain_4]	text (number, Min: 0, Max: 100)
780	[correct_4_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 4	Number Correct at Time 43 for [domain_4]	text (integer, Min: 0, Max: 100)
781	[outof_4_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 4	Out of what number at Time 43 for [domain_4]	text (number, Min: 0, Max: 100)

782	[perc_4_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 4	Percent Correct at Time 44 for [domain_4]	text (number, Min: 0, Max: 100)
783	[correct_4_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 4	Number Correct at Time 44 for [domain_4]	text (integer, Min: 0, Max: 100)

784	[outof_4_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 4	Out of what number at Time 44 for [domain_4]	text (number, Min: 0, Max: 100)
785	[perc_4_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 4	Percent Correct at Time 45 for [domain_4]	text (number, Min: 0, Max: 100)
786	[correct_4_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 4	Number Correct at Time 45 for [domain_4]	text (integer, Min: 0, Max: 100)
787	[outof_4_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 4	Out of what number at Time 45 for [domain_4]	text (number, Min: 0, Max: 100)
788	[perc_4_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 4	Percent Correct at Time 46 for [domain_4]	text (number, Min: 0, Max: 100)
789	[correct_4_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 4	Number Correct at Time 46 for [domain_4]	text (integer, Min: 0, Max: 100)
790	[outof_4_46] Show the field ONLY if: [time_numb] >=46 and [measure_numb] >= 4	Out of what number at Time 46 for [domain_4]	text (number, Min: 0, Max: 100)
791	[perc_4_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 4	Percent Correct at Time 47 for [domain_4]	text (number, Min: 0, Max: 100)
792	[correct_4_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 4	Number Correct at Time 47 for [domain_4]	text (integer, Min: 0, Max: 100)
793	[outof_4_47] Show the field ONLY if: [time_numb] >=47 and [measure_numb] >= 4	Out of what number at Time 47 for [domain_4]	text (number, Min: 0, Max: 100)
794	[perc_4_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 4	Percent Correct at Time 48 for [domain_4]	text (number, Min: 0, Max: 100)
795	[correct_4_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 4	Number Correct at Time 48 for [domain_4]	text (integer, Min: 0, Max: 100)

796	[outof_4_48] Show the field ONLY if: [time_numb] >=48 and [measure_numb] >= 4	Out of what number at Time 48 for [domain_4]	text (number, Min: 0, Max: 100)
797	[perc_4_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 4	Percent Correct at Time 49 for [domain_4]	text (number, Min: 0, Max: 100)

798	[correct_4_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 4	Number Correct at Time 49 for [domain_4]	text (integer, Min: 0, Max: 100)
799	[outof_4_49] Show the field ONLY if: [time_numb] >=49 and [measure_numb] >= 4	Out of what number at Time 49 for [domain_4]	text (number, Min: 0, Max: 100)
800	[perc_4_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 4	Percent Correct at Time 50 for [domain_4]	text (number, Min: 0, Max: 100)
801	[correct_4_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 4	Number Correct at Time 50 for [domain_4]	text (integer, Min: 0, Max: 100)
802	[outof_4_50] Show the field ONLY if: [time_numb] >=50 and [measure_numb] >= 4	Out of what number at Time 50 for [domain_4]	text (number, Min: 0, Max: 100)
803	[domain_5] Show the field ONLY if: [measure_numb] >= 5	Domain 5 (academic subject)	radio 10 Reading comprehension 20 Reading fluency 30 Math calculation
804	[domain_5_other] Show the field ONLY if: [domain_5] = '80'	If Other, please describe:	text
805	[perc_5_1] Show the field ONLY if: [measure_numb] >= 5	Percent Correct at Time 1 for [domain_5]	text (number, Min: 0, Max: 100)
806	[correct_5_1] Show the field ONLY if: [measure_numb] >= 5	Number Correct at Time 1 for [domain_5]	text (integer, Min: 0, Max: 100)
807	[outof_5_1] Show the field ONLY if: [measure_numb] >= 5	Out of what number at Time 1 for [domain_5]	text (number, Min: 0, Max: 100)
808	[perc_5_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 5	Percent Correct at Time 2 for [domain_5]	text (number, Min: 0, Max: 100)

809	[correct_5_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 5	Number Correct at Time 2 for [domain_5]	text (integer, Min: 0, Max: 100)
810	[outof_5_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 5	Out of what number at Time 2 for [domain_5]	text (number, Min: 0, Max: 100)

811	[perc_5_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 5	Percent Correct at Time 3 for [domain_5]	text (number, Min: 0, Max: 100)
812	[correct_5_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 5	Number Correct at Time 3 for [domain_5]	text (integer, Min: 0, Max: 100)
813	[outof_5_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 5	Out of what number at Time 3 for [domain_5]	text (number, Min: 0, Max: 100)
814	[correct_5_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 5	Number Correct at Time 4 for [domain_5]	text (integer, Min: 0, Max: 100)
815	[perc_5_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 5	Percent Correct at Time 4 for [domain_5]	text (number, Min: 0, Max: 100)
816	[outof_5_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 5	Out of what number at Time 4 for [domain_5]	text (number, Min: 0, Max: 100)
817	[perc_5_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 5	Percent Correct at Time 5 for [domain_5]	text (number, Min: 0, Max: 100)
818	[correct_5_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 5	Number Correct at Time 5 for [domain_5]	text (integer, Min: 0, Max: 100)
819	[outof_5_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 5	Out of what number at Time 5 for [domain_5]	text (number, Min: 0, Max: 100)
820	[perc_5_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 5	Percent Correct at Time 6 for [domain_5]	text (number, Min: 0, Max: 100)
821	[correct_5_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 5	Number Correct at Time 6 for [domain_5]	text (integer, Min: 0, Max: 100)
822	[outof_5_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 5	Out of what number at Time 6 for [domain_5]	text (number, Min: 0, Max: 100)

823	[perc_5_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 5	Percent Correct at Time 7 for [domain_5]	text (number, Min: 0, Max: 100)
824	[correct_5_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 5	Number Correct at Time 7 for [domain_5]	text (integer, Min: 0, Max: 100)

825	[outof_5_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 5	Out of what number at Time 7 for [domain_5]	text (number, Min: 0, Max: 100)
826	[perc_5_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 5	Percent Correct at Time 8 for [domain_5]	text (number, Min: 0, Max: 100)
827	[correct_5_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 5	Number Correct at Time 8 for [domain_5]	text (integer, Min: 0, Max: 100)
828	[outof_5_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 5	Out of what number at Time 8 for [domain_5]	text (number, Min: 0, Max: 100)
829	[perc_5_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 5	Percent Correct at Time 9 for [domain_5]	text (number, Min: 0, Max: 100)
830	[correct_5_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 5	Number Correct at Time 9 for [domain_5]	text (integer, Min: 0, Max: 100)
831	[outof_5_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 5	Out of what number at Time 9 for [domain_5]	text (number, Min: 0, Max: 100)
832	[perc_5_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 5	Percent Correct at Time 10 for [domain_5]	text (number, Min: 0, Max: 100)
833	[correct_5_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 5	Number Correct at Time 10 for [domain_5]	text (integer, Min: 0, Max: 100)
834	[outof_5_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 5	Out of what number at Time 10 for [domain_5]	text (number, Min: 0, Max: 100)
835	[perc_5_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 5	Percent Correct at Time 11 for [domain_5]	text (number, Min: 0, Max: 100)
836	[correct_5_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 5	Number Correct at Time 11 for [domain_5]	text (integer, Min: 0, Max: 100)

837	[outof_5_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 5	Out of what number at Time 11 for [domain_5]	text (number, Min: 0, Max: 100)
838	[perc_5_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 5	Percent Correct at Time 12 for [domain_5]	text (number, Min: 0, Max: 100)

839	[correct_5_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 5	Number Correct at Time 12 for [domain_5]	text (integer, Min: 0, Max: 100)
840	[outof_5_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 5	Out of what number at Time 12 for [domain_5]	text (number, Min: 0, Max: 100)
841	[perc_5_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 5	Percent Correct at Time 13 for [domain_5]	text (number, Min: 0, Max: 100)
842	[correct_5_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 5	Number Correct at Time 13 for [domain_5]	text (integer, Min: 0, Max: 100)
843	[outof_5_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 5	Out of what number at Time 13 for [domain_5]	text (number, Min: 0, Max: 100)
844	[perc_5_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 5	Percent Correct at Time 14 for [domain_5]	text (number, Min: 0, Max: 100)
845	[correct_5_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 5	Number Correct at Time 14 for [domain_5]	text (integer, Min: 0, Max: 100)
846	[outof_5_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 5	Out of what number at Time 14 for [domain_5]	text (number, Min: 0, Max: 100)
847	[perc_5_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 5	Percent Correct at Time 15 for [domain_5]	text (number, Min: 0, Max: 100)
848	[correct_5_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 5	Number Correct at Time 15 for [domain_5]	text (integer, Min: 0, Max: 100)
849	[outof_5_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 5	Out of what number at Time 15 for [domain_5]	text (number, Min: 0, Max: 100)
850	[perc_5_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 5	Percent Correct at Time 16 for [domain_5]	text (number, Min: 0, Max: 100)

851	[correct_5_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 5	Number Correct at Time 16 for [domain_5]	text (integer, Min: 0, Max: 100)
852	[outof_5_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 5	Out of what number at Time 16 for [domain_5]	text (number, Min: 0, Max: 100)

853	[perc_5_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 5	Percent Correct at Time 17 for [domain_5]	text (number, Min: 0, Max: 100)
854	[correct_5_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 5	Number Correct at Time 17 for [domain_5]	text (integer, Min: 0, Max: 100)
855	[outof_5_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 5	Out of what number at Time 17 for [domain_5]	text (number, Min: 0, Max: 100)
856	[perc_5_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 5	Percent Correct at Time 18 for [domain_5]	text (number, Min: 0, Max: 100)
857	[correct_5_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 5	Number Correct at Time 18 for [domain_5]	text (integer, Min: 0, Max: 100)
858	[outof_5_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 5	Out of what number at Time 18 for [domain_5]	text (number, Min: 0, Max: 100)
859	[perc_5_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 5	Percent Correct at Time 19 for [domain_5]	text (number, Min: 0, Max: 100)
860	[correct_5_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 5	Number Correct at Time 19 for [domain_5]	text (integer, Min: 0, Max: 100)
861	[outof_5_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 5	Out of what number at Time 19 for [domain_5]	text (number, Min: 0, Max: 100)
862	[perc_5_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 5	Percent Correct at Time 20 for [domain_5]	text (number, Min: 0, Max: 100)
863	[correct_5_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 5	Number Correct at Time 20 for [domain_5]	text (integer, Min: 0, Max: 100)
864	[outof_5_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 5	Out of what number at Time 20 for [domain_5]	text (number, Min: 0, Max: 100)

865	[perc_5_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 5	Percent Correct at Time 21 for [domain_5]	text (number, Min: 0, Max: 100)
866	[correct_5_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 5	Number Correct at Time 21 for [domain_5]	text (integer, Min: 0, Max: 100)

867	[outof_5_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 5	Out of what number at Time 21 for [domain_5]	text (number, Min: 0, Max: 100)
868	[perc_5_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 5	Percent Correct at Time 22 for [domain_5]	text (number, Min: 0, Max: 100)
869	[correct_5_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 5	Number Correct at Time 22 for [domain_5]	text (integer, Min: 0, Max: 100)
870	[outof_5_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 5	Out of what number at Time 22 for [domain_5]	text (number, Min: 0, Max: 100)
871	[perc_5_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 5	Percent Correct at Time 23 for [domain_5]	text (number, Min: 0, Max: 100)
872	[correct_5_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 5	Number Correct at Time 23 for [domain_5]	text (integer, Min: 0, Max: 100)
873	[outof_5_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 5	Out of what number at Time 23 for [domain_5]	text (number, Min: 0, Max: 100)
874	[perc_5_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 5	Percent Correct at Time 24 for [domain_5]	text (number, Min: 0, Max: 100)
875	[correct_5_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 5	Number Correct at Time 24 for [domain_5]	text (integer, Min: 0, Max: 100)
876	[outof_5_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 5	Out of what number at Time 24 for [domain_5]	text (number, Min: 0, Max: 100)
877	[perc_5_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 5	Percent Correct at Time 25 for [domain_5]	text (number, Min: 0, Max: 100)
878	[correct_5_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 5	Number Correct at Time 25 for [domain_5]	text (integer, Min: 0, Max: 100)

879	[outof_5_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 5	Out of what number at Time 25 for [domain_5]	text (number, Min: 0, Max: 100)
880	[perc_5_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 5	Percent Correct at Time 26 for [domain_5]	text (number, Min: 0, Max: 100)

881	[correct_5_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 5	Number Correct at Time 26 for [domain_5]	text (integer, Min: 0, Max: 100)
882	[outof_5_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 5	Out of what number at Time 26 for [domain_5]	text (number, Min: 0, Max: 100)
883	[perc_5_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 5	Percent Correct at Time 27 for [domain_5]	text (number, Min: 0, Max: 100)
884	[correct_5_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 5	Number Correct at Time 27 for [domain_5]	text (integer, Min: 0, Max: 100)
885	[outof_5_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 5	Out of what number at Time 27 for [domain_5]	text (number, Min: 0, Max: 100)
886	[perc_5_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 5	Percent Correct at Time 28 for [domain_5]	text (number, Min: 0, Max: 100)
887	[correct_5_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 5	Number Correct at Time 28 for [domain_5]	text (integer, Min: 0, Max: 100)
888	[outof_5_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 5	Out of what number at Time 28 for [domain_5]	text (number, Min: 0, Max: 100)
889	[perc_5_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 5	Percent Correct at Time 29 for [domain_5]	text (number, Min: 0, Max: 100)
890	[correct_5_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 5	Number Correct at Time 29 for [domain_5]	text (integer, Min: 0, Max: 100)
891	[outof_5_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 5	Out of what number at Time 29 for [domain_5]	text (number, Min: 0, Max: 100)
892	[perc_5_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 5	Percent Correct at Time 30 for [domain_5]	text (number, Min: 0, Max: 100)

893	[correct_5_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 5	Number Correct at Time 30 for [domain_5]	text (integer, Min: 0, Max: 100)
894	[outof_5_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 5	Out of what number at Time 30 for [domain_5]	text (number, Min: 0, Max: 100)

895	[perc_5_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 5	Percent Correct at Time 31 for [domain_5]	text (number, Min: 0, Max: 100)
896	[correct_5_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 5	Number Correct at Time 31 for [domain_5]	text (integer, Min: 0, Max: 100)
897	[outof_5_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 5	Out of what number at Time 31 for [domain_5]	text (number, Min: 0, Max: 100)
898	[perc_5_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 5	Percent Correct at Time 32 for [domain_5]	text (number, Min: 0, Max: 100)
899	[correct_5_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 5	Number Correct at Time 32 for [domain_5]	text (integer, Min: 0, Max: 100)
900	[outof_5_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 5	Out of what number at Time 32 for [domain_5]	text (number, Min: 0, Max: 100)
901	[perc_5_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 5	Percent Correct at Time 33 for [domain_5]	text (number, Min: 0, Max: 100)
902	[correct_5_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 5	Number Correct at Time 33 for [domain_5]	text (integer, Min: 0, Max: 100)
903	[outof_5_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 5	Out of what number at Time 33 for [domain_5]	text (number, Min: 0, Max: 100)
904	[perc_5_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 5	Percent Correct at Time 34 for [domain_5]	text (number, Min: 0, Max: 100)
905	[correct_5_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 5	Number Correct at Time 34 for [domain_5]	text (integer, Min: 0, Max: 100)
906	[outof_5_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 5	Out of what number at Time 34 for [domain_5]	text (number, Min: 0, Max: 100)

907	[perc_5_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 5	Percent Correct at Time 35 for [domain_5]	text (number, Min: 0, Max: 100)
908	[correct_5_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 5	Number Correct at Time 35 for [domain_5]	text (integer, Min: 0, Max: 100)

909	[outof_5_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 5	Out of what number at Time 35 for [domain_5]	text (number, Min: 0, Max: 100)
910	[perc_5_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 5	Percent Correct at Time 36 for [domain_5]	text (number, Min: 0, Max: 100)
911	[correct_5_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 5	Number Correct at Time 36 for [domain_5]	text (integer, Min: 0, Max: 100)
912	[outof_5_36] Show the field ONLY if: [time_numb] >=36 and [measure_numb] >= 5	Out of what number at Time 36 for [domain_5]	text (number, Min: 0, Max: 100)
913	[perc_5_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 5	Percent Correct at Time 37 for [domain_5]	text (number, Min: 0, Max: 100)
914	[correct_5_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 5	Number Correct at Time 37 for [domain_5]	text (integer, Min: 0, Max: 100)
915	[outof_5_37] Show the field ONLY if: [time_numb] >=37 and [measure_numb] >= 5	Out of what number at Time 37 for [domain_5]	text (number, Min: 0, Max: 100)
916	[perc_5_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 5	Percent Correct at Time 38 for [domain_5]	text (number, Min: 0, Max: 100)
917	[correct_5_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 5	Number Correct at Time 38 for [domain_5]	text (integer, Min: 0, Max: 100)
918	[outof_5_38] Show the field ONLY if: [time_numb] >=38 and [measure_numb] >= 5	Out of what number at Time 38 for [domain_5]	text (number, Min: 0, Max: 100)
919	[perc_5_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 5	Percent Correct at Time 39 for [domain_5]	text (number, Min: 0, Max: 100)
920	[correct_5_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 5	Number Correct at Time 39 for [domain_5]	text (integer, Min: 0, Max: 100)

921	[outof_5_39] Show the field ONLY if: [time_numb] >=39 and [measure_numb] >= 5	Out of what number at Time 39 for [domain_5]	text (number, Min: 0, Max: 100)
922	[perc_5_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 5	Percent Correct at Time 40 for [domain_5]	text (number, Min: 0, Max: 100)

923	[correct_5_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 5	Number Correct at Time 40 for [domain_5]	text (integer, Min: 0, Max: 100)
924	[outof_5_40] Show the field ONLY if: [time_numb] >=40 and [measure_numb] >= 5	Out of what number at Time 40 for [domain_5]	text (number, Min: 0, Max: 100)
925	[perc_5_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 5	Percent Correct at Time 41 for [domain_5]	text (number, Min: 0, Max: 100)
926	[correct_5_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 5	Number Correct at Time 41 for [domain_5]	text (integer, Min: 0, Max: 100)
927	[outof_5_41] Show the field ONLY if: [time_numb] >=41 and [measure_numb] >= 5	Out of what number at Time 41 for [domain_5]	text (number, Min: 0, Max: 100)
928	[perc_5_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 5	Percent Correct at Time 42 for [domain_5]	text (number, Min: 0, Max: 100)
929	[correct_5_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 5	Number Correct at Time 42 for [domain_5]	text (integer, Min: 0, Max: 100)
930	[outof_5_42] Show the field ONLY if: [time_numb] >=42 and [measure_numb] >= 5	Out of what number at Time 42 for [domain_5]	text (number, Min: 0, Max: 100)
931	[perc_5_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 5	Percent Correct at Time 43 for [domain_5]	text (number, Min: 0, Max: 100)
932	[correct_5_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 5	Number Correct at Time 43 for [domain_5]	text (integer, Min: 0, Max: 100)
933	[outof_5_43] Show the field ONLY if: [time_numb] >=43 and [measure_numb] >= 5	Out of what number at Time 43 for [domain_5]	text (number, Min: 0, Max: 100)
934	[perc_5_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 5	Percent Correct at Time 44 for [domain_5]	text (number, Min: 0, Max: 100)

935	[correct_5_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 5	Number Correct at Time 44 for [domain_5]	text (integer, Min: 0, Max: 100)
936	[outof_5_44] Show the field ONLY if: [time_numb] >=44 and [measure_numb] >= 5	Out of what number at Time 44 for [domain_5]	text (number, Min: 0, Max: 100)

937	[perc_5_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 5	Percent Correct at Time 45 for [domain_5]	text (number, Min: 0, Max: 100)
938	[correct_5_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 5	Number Correct at Time 45 for [domain_5]	text (integer, Min: 0, Max: 100)
939	[outof_5_45] Show the field ONLY if: [time_numb] >=45 and [measure_numb] >= 5	Out of what number at Time 45 for [domain_5]	text (number, Min: 0, Max: 100)
940	[domain_6] Show the field ONLY if: [measure_numb] >= 6	Domain 6 (academic subject)	radio 10 Reading comprehension 20 Reading fluency 30 Math calculation
941	[domain_6_other] Show the field ONLY if: [domain_6] = '80'	If Other, please describe:	text
942	[perc_6_1] Show the field ONLY if: [measure_numb] >= 6	Percent Correct at Time 1 for [domain_6]	text (number, Min: 0, Max: 100)
943	[correct_6_1] Show the field ONLY if: [measure_numb] >= 6	Number Correct at Time 1 for [domain_6]	text (integer, Min: 0, Max: 100)
944	[outof_6_1] Show the field ONLY if: [measure_numb] >= 6	Out of what number at Time 1 for [domain_6]	text (number, Min: 0, Max: 100)
945	[perc_6_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 6	Percent Correct at Time 2 for [domain_6]	text (number, Min: 0, Max: 100)
946	[correct_6_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 6	Number Correct at Time 2 for [domain_6]	text (integer, Min: 0, Max: 100)
947	[outof_6_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 6	Out of what number at Time 2 for [domain_6]	text (number, Min: 0, Max: 100)

948	[perc_6_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 6	Percent Correct at Time 3 for [domain_6]	text (number, Min: 0, Max: 100)
949	[correct_6_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 6	Number Correct at Time 3 for [domain_6]	text (integer, Min: 0, Max: 100)

950	[outof_6_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 6	Out of what number at Time 3 for [domain_6]	text (number, Min: 0, Max: 100)
951	[correct_6_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 6	Number Correct at Time 4 for [domain_6]	text (integer, Min: 0, Max: 100)
952	[perc_6_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 6	Percent Correct at Time 4 for [domain_6]	text (number, Min: 0, Max: 100)
953	[outof_6_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 6	Out of what number at Time 4 for [domain_6]	text (number, Min: 0, Max: 100)
954	[perc_6_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 6	Percent Correct at Time 5 for [domain_6]	text (number, Min: 0, Max: 100)
955	[correct_6_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 6	Number Correct at Time 5 for [domain_6]	text (integer, Min: 0, Max: 100)
956	[outof_6_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 6	Out of what number at Time 5 for [domain_6]	text (number, Min: 0, Max: 100)
957	[perc_6_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 6	Percent Correct at Time 6 for [domain_6]	text (number, Min: 0, Max: 100)
958	[correct_6_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 6	Number Correct at Time 6 for [domain_6]	text (integer, Min: 0, Max: 100)
959	[outof_6_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 6	Out of what number at Time 6 for [domain_6]	text (number, Min: 0, Max: 100)
960	[perc_6_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 6	Percent Correct at Time 7 for [domain_6]	text (number, Min: 0, Max: 100)
961	[correct_6_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 6	Number Correct at Time 7 for [domain_6]	text (integer, Min: 0, Max: 100)

962	[outof_6_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 6	Out of what number at Time 7 for [domain_6]	text (number, Min: 0, Max: 100)
963	[perc_6_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 6	Percent Correct at Time 8 for [domain_6]	text (number, Min: 0, Max: 100)

964	[correct_6_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 6	Number Correct at Time 8 for [domain_6]	text (integer, Min: 0, Max: 100)
965	[outof_6_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 6	Out of what number at Time 8 for [domain_6]	text (number, Min: 0, Max: 100)
966	[perc_6_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 6	Percent Correct at Time 9 for [domain_6]	text (number, Min: 0, Max: 100)
967	[correct_6_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 6	Number Correct at Time 9 for [domain_6]	text (integer, Min: 0, Max: 100)
968	[outof_6_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 6	Out of what number at Time 9 for [domain_6]	text (number, Min: 0, Max: 100)
969	[perc_6_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 6	Percent Correct at Time 10 for [domain_6]	text (number, Min: 0, Max: 100)
970	[correct_6_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 6	Number Correct at Time 10 for [domain_6]	text (integer, Min: 0, Max: 100)
971	[outof_6_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 6	Out of what number at Time 10 for [domain_6]	text (number, Min: 0, Max: 100)
972	[perc_6_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 6	Percent Correct at Time 11 for [domain_6]	text (number, Min: 0, Max: 100)
973	[correct_6_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 6	Number Correct at Time 11 for [domain_6]	text (integer, Min: 0, Max: 100)
974	[outof_6_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 6	Out of what number at Time 11 for [domain_6]	text (number, Min: 0, Max: 100)
975	[perc_6_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 6	Percent Correct at Time 12 for [domain_6]	text (number, Min: 0, Max: 100)

976	[correct_6_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 6	Number Correct at Time 12 for [domain_6]	text (integer, Min: 0, Max: 100)
977	[outof_6_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 6	Out of what number at Time 12 for [domain_6]	text (number, Min: 0, Max: 100)

978	[perc_6_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 6	Percent Correct at Time 13 for [domain_6]	text (number, Min: 0, Max: 100)
979	[correct_6_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 6	Number Correct at Time 13 for [domain_6]	text (integer, Min: 0, Max: 100)
980	[outof_6_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 6	Out of what number at Time 13 for [domain_6]	text (number, Min: 0, Max: 100)
981	[perc_6_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 6	Percent Correct at Time 14 for [domain_6]	text (number, Min: 0, Max: 100)
982	[correct_6_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 6	Number Correct at Time 14 for [domain_6]	text (integer, Min: 0, Max: 100)
983	[outof_6_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 6	Out of what number at Time 14 for [domain_6]	text (number, Min: 0, Max: 100)
984	[perc_6_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 6	Percent Correct at Time 15 for [domain_6]	text (number, Min: 0, Max: 100)
985	[correct_6_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 6	Number Correct at Time 15 for [domain_6]	text (integer, Min: 0, Max: 100)
986	[outof_6_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 6	Out of what number at Time 15 for [domain_6]	text (number, Min: 0, Max: 100)
987	[perc_6_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 6	Percent Correct at Time 16 for [domain_6]	text (number, Min: 0, Max: 100)
988	[correct_6_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 6	Number Correct at Time 16 for [domain_6]	text (integer, Min: 0, Max: 100)
989	[outof_6_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 6	Out of what number at Time 16 for [domain_6]	text (number, Min: 0, Max: 100)

990	[perc_6_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 6	Percent Correct at Time 17 for [domain_6]	text (number, Min: 0, Max: 100)
991	[correct_6_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 6	Number Correct at Time 17 for [domain_6]	text (integer, Min: 0, Max: 100)

992	[outof_6_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 6	Out of what number at Time 17 for [domain_6]	text (number, Min: 0, Max: 100)
993	[perc_6_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 6	Percent Correct at Time 18 for [domain_6]	text (number, Min: 0, Max: 100)
994	[correct_6_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 6	Number Correct at Time 18 for [domain_6]	text (integer, Min: 0, Max: 100)
995	[outof_6_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 6	Out of what number at Time 18 for [domain_6]	text (number, Min: 0, Max: 100)
996	[perc_6_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 6	Percent Correct at Time 19 for [domain_6]	text (number, Min: 0, Max: 100)
997	[correct_6_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 6	Number Correct at Time 19 for [domain_6]	text (integer, Min: 0, Max: 100)
998	[outof_6_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 6	Out of what number at Time 19 for [domain_6]	text (number, Min: 0, Max: 100)
999	[perc_6_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 6	Percent Correct at Time 20 for [domain_6]	text (number, Min: 0, Max: 100)
1000	[correct_6_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 6	Number Correct at Time 20 for [domain_6]	text (integer, Min: 0, Max: 100)
1001	[outof_6_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 6	Out of what number at Time 20 for [domain_6]	text (number, Min: 0, Max: 100)
1002	[perc_6_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 6	Percent Correct at Time 21 for [domain_6]	text (number, Min: 0, Max: 100)
1003	[correct_6_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 6	Number Correct at Time 21 for [domain_6]	text (integer, Min: 0, Max: 100)

1004	[outof_6_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 6	Out of what number at Time 21 for [domain_6]	text (number, Min: 0, Max: 100)
1005	[perc_6_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 6	Percent Correct at Time 22 for [domain_6]	text (number, Min: 0, Max: 100)

1006	[correct_6_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 6	Number Correct at Time 22 for [domain_6]	text (integer, Min: 0, Max: 100)
1007	[outof_6_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 6	Out of what number at Time 22 for [domain_6]	text (number, Min: 0, Max: 100)
1008	[perc_6_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 6	Percent Correct at Time 23 for [domain_6]	text (number, Min: 0, Max: 100)
1009	[correct_6_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 6	Number Correct at Time 23 for [domain_6]	text (integer, Min: 0, Max: 100)
1010	[outof_6_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 6	Out of what number at Time 23 for [domain_6]	text (number, Min: 0, Max: 100)
1011	[perc_6_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 6	Percent Correct at Time 24 for [domain_6]	text (number, Min: 0, Max: 100)
1012	[correct_6_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 6	Number Correct at Time 24 for [domain_6]	text (integer, Min: 0, Max: 100)
1013	[outof_6_24] Show the field ONLY if: [time_numb] >=24 and [measure_numb] >= 6	Out of what number at Time 24 for [domain_6]	text (number, Min: 0, Max: 100)
1014	[perc_6_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 6	Percent Correct at Time 25 for [domain_6]	text (number, Min: 0, Max: 100)
1015	[correct_6_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 6	Number Correct at Time 25 for [domain_6]	text (integer, Min: 0, Max: 100)
1016	[outof_6_25] Show the field ONLY if: [time_numb] >=25 and [measure_numb] >= 6	Out of what number at Time 25 for [domain_6]	text (number, Min: 0, Max: 100)
1017	[perc_6_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 6	Percent Correct at Time 26 for [domain_6]	text (number, Min: 0, Max: 100)

1018	[correct_6_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 6	Number Correct at Time 26 for [domain_6]	text (integer, Min: 0, Max: 100)
1019	[outof_6_26] Show the field ONLY if: [time_numb] >=26 and [measure_numb] >= 6	Out of what number at Time 26 for [domain_6]	text (number, Min: 0, Max: 100)

1020	[perc_6_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 6	Percent Correct at Time 27 for [domain_6]	text (number, Min: 0, Max: 100)
1021	[correct_6_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 6	Number Correct at Time 27 for [domain_6]	text (integer, Min: 0, Max: 100)
1022	[outof_6_27] Show the field ONLY if: [time_numb] >=27 and [measure_numb] >= 6	Out of what number at Time 27 for [domain_6]	text (number, Min: 0, Max: 100)
1023	[perc_6_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 6	Percent Correct at Time 28 for [domain_6]	text (number, Min: 0, Max: 100)
1024	[correct_6_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 6	Number Correct at Time 28 for [domain_6]	text (integer, Min: 0, Max: 100)
1025	[outof_6_28] Show the field ONLY if: [time_numb] >=28 and [measure_numb] >= 6	Out of what number at Time 28 for [domain_6]	text (number, Min: 0, Max: 100)
1026	[perc_6_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 6	Percent Correct at Time 29 for [domain_6]	text (number, Min: 0, Max: 100)
1027	[correct_6_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 6	Number Correct at Time 29 for [domain_6]	text (integer, Min: 0, Max: 100)
1028	[outof_6_29] Show the field ONLY if: [time_numb] >=29 and [measure_numb] >= 6	Out of what number at Time 29 for [domain_6]	text (number, Min: 0, Max: 100)
1029	[perc_6_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 6	Percent Correct at Time 30 for [domain_6]	text (number, Min: 0, Max: 100)
1030	[correct_6_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 6	Number Correct at Time 30 for [domain_6]	text (integer, Min: 0, Max: 100)
1031	[outof_6_30] Show the field ONLY if: [time_numb] >=30 and [measure_numb] >= 6	Out of what number at Time 30 for [domain_6]	text (number, Min: 0, Max: 100)

1032	[perc_6_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 6	Percent Correct at Time 31 for [domain_6]	text (number, Min: 0, Max: 100)
1033	[correct_6_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 6	Number Correct at Time 31 for [domain_6]	text (integer, Min: 0, Max: 100)

1034	[outof_6_31] Show the field ONLY if: [time_numb] >=31 and [measure_numb] >= 6	Out of what number at Time 31 for [domain_6]	text (number, Min: 0, Max: 100)
1035	[perc_6_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 6	Percent Correct at Time 32 for [domain_6]	text (number, Min: 0, Max: 100)
1036	[correct_6_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 6	Number Correct at Time 32 for [domain_6]	text (integer, Min: 0, Max: 100)
1037	[outof_6_32] Show the field ONLY if: [time_numb] >=32 and [measure_numb] >= 6	Out of what number at Time 32 for [domain_6]	text (number, Min: 0, Max: 100)
1038	[perc_6_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 6	Percent Correct at Time 33 for [domain_6]	text (number, Min: 0, Max: 100)
1039	[correct_6_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 6	Number Correct at Time 33 for [domain_6]	text (integer, Min: 0, Max: 100)
1040	[outof_6_33] Show the field ONLY if: [time_numb] >=33 and [measure_numb] >= 6	Out of what number at Time 33 for [domain_6]	text (number, Min: 0, Max: 100)
1041	[perc_6_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 6	Percent Correct at Time 34 for [domain_6]	text (number, Min: 0, Max: 100)
1042	[correct_6_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 6	Number Correct at Time 34 for [domain_6]	text (integer, Min: 0, Max: 100)
1043	[outof_6_34] Show the field ONLY if: [time_numb] >=34 and [measure_numb] >= 6	Out of what number at Time 34 for [domain_6]	text (number, Min: 0, Max: 100)
1044	[perc_6_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 6	Percent Correct at Time 35 for [domain_6]	text (number, Min: 0, Max: 100)
1045	[correct_6_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 6	Number Correct at Time 35 for [domain_6]	text (integer, Min: 0, Max: 100)

1046	[outof_6_35] Show the field ONLY if: [time_numb] >=35 and [measure_numb] >= 6	Out of what number at Time 35 for [domain_6]	text (number, Min: 0, Max: 100)

1047	[domain_7] Show the field ONLY if: [measure_numb] >= 7	Domain 7 (academic subject)	radio 10 Reading comprehension 20 Reading fluency 30 Math calculation
1048	[domain_7_other] Show the field ONLY if: [domain_7] = '80'	If Other, please describe:	text
1049	[perc_7_1] Show the field ONLY if: [measure_numb] >= 7	Percent Correct at Time 1 for [domain_7]	text (number, Min: 0, Max: 100)
1050	[correct_7_1] Show the field ONLY if: [measure_numb] >= 7	Number Correct at Time 1 for [domain_7]	text (integer, Min: 0, Max: 100)
1051	[outof_7_1] Show the field ONLY if: [measure_numb] >= 7	Out of what number at Time 1 for [domain_7]	text (number, Min: 0, Max: 100)
1052	[perc_7_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 7	Percent Correct at Time 2 for [domain_7]	text (number, Min: 0, Max: 100)
1053	[correct_7_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 7	Number Correct at Time 2 for [domain_7]	text (integer, Min: 0, Max: 100)
1054	[outof_7_2] Show the field ONLY if: [time_numb] >= 2 and [measure_numb] >= 7	Out of what number at Time 2 for [domain_7]	text (number, Min: 0, Max: 100)
1055	[perc_7_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 7	Percent Correct at Time 3 for [domain_7]	text (number, Min: 0, Max: 100)
1056	[correct_7_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 7	Number Correct at Time 3 for [domain_7]	text (integer, Min: 0, Max: 100)
1057	[outof_7_3] Show the field ONLY if: [time_numb] >=3 and [measure_numb] >= 7	Out of what number at Time 3 for [domain_7]	text (number, Min: 0, Max: 100)

1058	[correct_7_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 7	Number Correct at Time 4 for [domain_7]	text (integer, Min: 0, Max: 100)
1059	[perc_7_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 7	Percent Correct at Time 4 for [domain_7]	text (number, Min: 0, Max: 100)

1060	[outof_7_4] Show the field ONLY if: [time_numb] >=4 and [measure_numb] >= 7	Out of what number at Time 4 for [domain_7]	text (number, Min: 0, Max: 100)
1061	[perc_7_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 7	Percent Correct at Time 5 for [domain_7]	text (number, Min: 0, Max: 100)
1062	[correct_7_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 7	Number Correct at Time 5 for [domain_7]	text (integer, Min: 0, Max: 100)
1063	[outof_7_5] Show the field ONLY if: [time_numb] >=5 and [measure_numb] >= 7	Out of what number at Time 5 for [domain_7]	text (number, Min: 0, Max: 100)
1064	[perc_7_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 7	Percent Correct at Time 6 for [domain_7]	text (number, Min: 0, Max: 100)
1065	[correct_7_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 7	Number Correct at Time 6 for [domain_7]	text (integer, Min: 0, Max: 100)
1066	[outof_7_6] Show the field ONLY if: [time_numb] >=6 and [measure_numb] >= 7	Out of what number at Time 6 for [domain_7]	text (number, Min: 0, Max: 100)
1067	[perc_7_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 7	Percent Correct at Time 7 for [domain_7]	text (number, Min: 0, Max: 100)
1068	[correct_7_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 7	Number Correct at Time 7 for [domain_7]	text (integer, Min: 0, Max: 100)
1069	[outof_7_7] Show the field ONLY if: [time_numb] >=7 and [measure_numb] >= 7	Out of what number at Time 7 for [domain_7]	text (number, Min: 0, Max: 100)
1070	[perc_7_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 7	Percent Correct at Time 8 for [domain_7]	text (number, Min: 0, Max: 100)
1071	[correct_7_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 7	Number Correct at Time 8 for [domain_7]	text (integer, Min: 0, Max: 100)

1072	[outof_7_8] Show the field ONLY if: [time_numb] >=8 and [measure_numb] >= 7	Out of what number at Time 8 for [domain_7]	text (number, Min: 0, Max: 100)
1073	[perc_7_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 7	Percent Correct at Time 9 for [domain_7]	text (number, Min: 0, Max: 100)

1074	[correct_7_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 7	Number Correct at Time 9 for [domain_7]	text (integer, Min: 0, Max: 100)
1075	[outof_7_9] Show the field ONLY if: [time_numb] >=9 and [measure_numb] >= 7	Out of what number at Time 9 for [domain_7]	text (number, Min: 0, Max: 100)
1076	[perc_7_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 7	Percent Correct at Time 10 for [domain_7]	text (number, Min: 0, Max: 100)
1077	[correct_7_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 7	Number Correct at Time 10 for [domain_7]	text (integer, Min: 0, Max: 100)
1078	[outof_7_10] Show the field ONLY if: [time_numb] >=10 and [measure_numb] >= 7	Out of what number at Time 10 for [domain_7]	text (number, Min: 0, Max: 100)
1079	[perc_7_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 7	Percent Correct at Time 11 for [domain_7]	text (number, Min: 0, Max: 100)
1080	[correct_7_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 7	Number Correct at Time 11 for [domain_7]	text (integer, Min: 0, Max: 100)
1081	[outof_7_11] Show the field ONLY if: [time_numb] >=11 and [measure_numb] >= 7	Out of what number at Time 11 for [domain_7]	text (number, Min: 0, Max: 100)
1082	[perc_7_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 7	Percent Correct at Time 12 for [domain_7]	text (number, Min: 0, Max: 100)
1083	[correct_7_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 7	Number Correct at Time 12 for [domain_7]	text (integer, Min: 0, Max: 100)
1084	[outof_7_12] Show the field ONLY if: [time_numb] >=12 and [measure_numb] >= 7	Out of what number at Time 12 for [domain_7]	text (number, Min: 0, Max: 100)
1085	[perc_7_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 7	Percent Correct at Time 13 for [domain_7]	text (number, Min: 0, Max: 100)

1086	[correct_7_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 7	Number Correct at Time 13 for [domain_7]	text (integer, Min: 0, Max: 100)
1087	[outof_7_13] Show the field ONLY if: [time_numb] >=13 and [measure_numb] >= 7	Out of what number at Time 13 for [domain_7]	text (number, Min: 0, Max: 100)

1088	[perc_7_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 7	Percent Correct at Time 14 for [domain_7]	text (number, Min: 0, Max: 100)
1089	[correct_7_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 7	Number Correct at Time 14 for [domain_7]	text (integer, Min: 0, Max: 100)
1090	[outof_7_14] Show the field ONLY if: [time_numb] >=14 and [measure_numb] >= 7	Out of what number at Time 14 for [domain_7]	text (number, Min: 0, Max: 100)
1091	[perc_7_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 7	Percent Correct at Time 15 for [domain_7]	text (number, Min: 0, Max: 100)
1092	[correct_7_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 7	Number Correct at Time 15 for [domain_7]	text (integer, Min: 0, Max: 100)
1093	[outof_7_15] Show the field ONLY if: [time_numb] >=15 and [measure_numb] >= 7	Out of what number at Time 15 for [domain_7]	text (number, Min: 0, Max: 100)
1094	[perc_7_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 7	Percent Correct at Time 16 for [domain_7]	text (number, Min: 0, Max: 100)
1095	[correct_7_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 7	Number Correct at Time 16 for [domain_7]	text (integer, Min: 0, Max: 100)
1096	[outof_7_16] Show the field ONLY if: [time_numb] >=16 and [measure_numb] >= 7	Out of what number at Time 16 for [domain_7]	text (number, Min: 0, Max: 100)
1097	[perc_7_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 7	Percent Correct at Time 17 for [domain_7]	text (number, Min: 0, Max: 100)
1098	[correct_7_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 7	Number Correct at Time 17 for [domain_7]	text (integer, Min: 0, Max: 100)
1099	[outof_7_17] Show the field ONLY if: [time_numb] >=17 and [measure_numb] >= 7	Out of what number at Time 17 for [domain_7]	text (number, Min: 0, Max: 100)

1100	[perc_7_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 7	Percent Correct at Time 18 for [domain_7]	text (number, Min: 0, Max: 100)
1101	[correct_7_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 7	Number Correct at Time 18 for [domain_7]	text (integer, Min: 0, Max: 100)

1102	[outof_7_18] Show the field ONLY if: [time_numb] >=18 and [measure_numb] >= 7	Out of what number at Time 18 for [domain_7]	text (number, Min: 0, Max: 100)
1103	[perc_7_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 7	Percent Correct at Time 19 for [domain_7]	text (number, Min: 0, Max: 100)
1104	[correct_7_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 7	Number Correct at Time 19 for [domain_7]	text (integer, Min: 0, Max: 100)
1105	[outof_7_19] Show the field ONLY if: [time_numb] >=19 and [measure_numb] >= 7	Out of what number at Time 19 for [domain_7]	text (number, Min: 0, Max: 100)
1106	[perc_7_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 7	Percent Correct at Time 20 for [domain_7]	text (number, Min: 0, Max: 100)
1107	[correct_7_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 7	Number Correct at Time 20 for [domain_7]	text (integer, Min: 0, Max: 100)
1108	[outof_7_20] Show the field ONLY if: [time_numb] >=20 and [measure_numb] >= 7	Out of what number at Time 20 for [domain_7]	text (number, Min: 0, Max: 100)
1109	[perc_7_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 7	Percent Correct at Time 21 for [domain_7]	text (number, Min: 0, Max: 100)
1110	[correct_7_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 7	Number Correct at Time 21 for [domain_7]	text (integer, Min: 0, Max: 100)
1111	[outof_7_21] Show the field ONLY if: [time_numb] >=21 and [measure_numb] >= 7	Out of what number at Time 21 for [domain_7]	text (number, Min: 0, Max: 100)
1112	[perc_7_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 7	Percent Correct at Time 22 for [domain_7]	text (number, Min: 0, Max: 100)
1113	[correct_7_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 7	Number Correct at Time 22 for [domain_7]	text (integer, Min: 0, Max: 100)

1114	[outof_7_22] Show the field ONLY if: [time_numb] >=22 and [measure_numb] >= 7	Out of what number at Time 22 for [domain_7]	text (number, Min: 0, Max: 100)
1115	[perc_7_23] Show the field ONLY if: [time_numb] >=23 and [measure_numb] >= 7	Percent Correct at Time 23 for [domain_7]	text (number, Min: 0, Max: 100)

1116	[correct_7_23] Show the field ONLY if: [time_numb] >=23 and [meas ure_numb] >= 7	Number Correct at Time 23 for [domain_7]	text (integer, Min: 0, Max: 100)
1117	[outof_7_23] Show the field ONLY if: [time_numb] >=23 and [meas ure_numb] >= 7	Out of what number at Time 23 for [domain_7]	text (number, Min: 0, Max: 100)
1118	[perc_7_24] Show the field ONLY if: [time_numb] >=24 and [meas ure_numb] >= 7	Percent Correct at Time 24 for [domain_7]	text (number, Min: 0, Max: 100)
1119	[correct_7_24] Show the field ONLY if: [time_numb] >=24 and [meas ure_numb] >= 7	Number Correct at Time 24 for [domain_7]	text (integer, Min: 0, Max: 100)
1120	[outof_7_24] Show the field ONLY if: [time_numb] >=24 and [meas ure_numb] >= 7	Out of what number at Time 24 for [domain_7]	text (number, Min: 0, Max: 100)
1121	[perc_7_25] Show the field ONLY if: [time_numb] >=25 and [meas ure_numb] >= 7	Percent Correct at Time 25 for [domain_7]	text (number, Min: 0, Max: 100)
1122	[correct_7_25] Show the field ONLY if: [time_numb] >=25 and [meas ure_numb] >= 7	Number Correct at Time 25 for [domain_7]	text (integer, Min: 0, Max: 100)
1123	[outof_7_25] Show the field ONLY if: [time_numb] >=25 and [meas ure_numb] >= 7	Out of what number at Time 25 for [domain_7]	text (number, Min: 0, Max: 100)
1124	[child_data_entry_app_ma _complete]	Section Header: *Form Status* Complete?	dropdown 0 Incomplete

Appendix C. Qualitative Questions Used During Interviews

Questions/behavior observations for primary caregivers to be collected during interviews.

1. Do you use academic apps with your child with autism in the home setting?

2. What are some current academic apps that your child uses at home?

3. What do you think are potential benefits to using academic apps?

4. What are some features in academic apps that you think are most beneficial to your child?

5. What do you think are potential challenges or difficulties to using academic apps?

6. How would describe your child's engagement and enjoyment when using academic apps?

7. Please describe how you work with your child's healthcare providers when choosing academic apps for your child.

8. Please describe how you work with education professionals when choosing academic apps for your child.

9. Please describe how you choose academic apps for your child in the home setting.

10. How have autism-specific apps worked for your child as compared to academic apps made for all children broadly?

11. If you could discuss the creation of academic apps with scientists who design them, what are the most important things you would want to share regarding creating apps that work well for children with autism?

General Behavior Observations:

Engagement, Tone, Body language, Focus on the Child vs. App

Appendix D. Quantitative Analysis Supplemental Material

Appendix D: Quantitative Analysis Supplemental Material

Contents

List of Tables

List of Figures

1 Workspace Preparation

1.1 Load Packages

1.1.1 CRAN

```
library(magrittr)
library(tidyverse)      # Easily Install and Load the 'Tidyverse'
library(broom)          # Convert Statistical Analysis Objects
library(purrr)          # Functional Programming Tools
library(xtable)         # Export Tables to LaTeX or HTML
library(pander)         # nice looking general tabulations
library(nlme)           # Linear and Nonlinear Mixed Effects Models
library(scdhlm)         # Hierarchical Linear Models for SCDs
library(robumeta)       # Robust Variance Meta-Regression
library(metafor)        # Meta-Analysis Package for R
library(SingleCaseES)   # Single Case Design Study Effect Sizes
library(clubSandwich)   # Robust variance
library(texreg)         # Convert Regression Output to LaTeX Tables
library(effects)        # Plotting estimated marginal means
library(gridExtra)      # combining graphics
```

1.1.2 GitHub

```
# install.packages("devtools")
library(devtools)

# install_github("SarBearSchwartz/texreghelpr")
library(texreghelpr)
```

1.2 Custom Functions

1.2.1 Calculation of BC-SMD to Apply Group-Wise

HPS = Hedges, Pustejovsky, & Shadish (2013)

- `delta_hat_unadj` unadjusted effect size estimate
- `delta_hat` corrected effect size estimate
- `V_delta_hat` estimated variance of delta_hat

Use the `effect_size_MB` function from the `scdhlm` package.

Calculates the HPS effect size estimator based on data from a multiple baseline design, as described in Hedges, Pustejovsky, & Shadish (2013). Note that the data must contain one row per measurement occasion per participant

```
bc_smd <- function(df){
  es <- scdhlm::effect_size_MB(outcome   = df$score_per,
                               treatment = df$phase,
                               id        = df$sub_dom,
                               time      = df$dayc)
  es %>%
    unlist()
}
```

1.2.2 Extract Estimates

```
extract_g <- function(x){
  x[c("g_AB", "SE_g_AB")]
}
```

1.2.3 Meta Regression Table Creation

```
meta_regress_table <- function
(fit_rma, cap = "Caption", cut = "", replace = NA){

  n = nchar(cut) + 1
  term_names <- rownames(fit_rma$beta) %>%
    stringr::str_sub(start = n)

  if(sum(is.na(replace)) == 0){term_names = replace}

  fit_rma %>%
    clubSandwich::coef_test(vcov = "CR2",
                            test = "Satterthwaite") %>%
    data.frame() %>%
    dplyr::mutate(expb = exp(beta),
                  CI_L           = beta - SE * qt(0.975, df = df_Satt),
                  CI_U           = beta + SE * qt(0.975, df = df_Satt),
                  per_change_est = 100*(exp(beta) - 1),
                  per_change_95l = 100*(exp(CI_L) - 1),
                  per_change_95u = 100*(exp(CI_U) - 1)) %>%
    dplyr::mutate(terms = term_names) %>%
    dplyr::select("Term"            = terms,
                  "Beta" = beta,
                  "expB" = expb,
                  "Percent Increase" = per_change_est,
                  "Lower 95 CI"      = per_change_95l,
                  "Upper 95 CI"      = per_change_95u,
                  "Sig."             = p_Satt) %>%
    xtable::xtable(caption = cap,
        digits = c(0, 2, 2, 2, 0, 0, 0, 3),
        align = c("l", "l", "l", "l", "c", "r", "l", "r")) %>%
    print(booktabs = TRUE,
          comment = FALSE,
          include.rownames = FALSE,
          caption.placement = "top")
}
```

2 Data Preparation

2.1 Load Dataset

```
load("/Users/sprlusu/Downloads/df_child_domain_day.RData")
```

2.2 Longer Format

One line per combination of study (n = 8), child (n = 21), domain, and day/session, for a total of n = 531 lines of data.

```
df_clean <- df_child_domain_day %>%
  dplyr::mutate(score_per = case_when(!is.na(outof) ~ correct/outof,
                                      is.na(outof) ~ perc)) %>%
  dplyr::mutate(num_cor = score_per * outof,
                num_inc = outof - correct) %>%
  dplyr::mutate(age_cat = cut(sub_age_years,
                              breaks = c(1, 6, 12),
                              include.lowest = TRUE) %>%
                forcats::fct_recode("Up to Six" = "[1,6]",
                                    "Over Six" = "(6,12]")) %>%
  dplyr::mutate(study_num = study_id  %>%
                fct_recode("1" = "Browder2017",
                           "2" = "Jowett2012",
                           "3" = "Keating2018",
                           "4" = "OBrien2018",
                           "5" = "Root2016",
                           "6" = "Root2019",
                           "7" = "Smith2013",
                           "8" = "Weng2014")) %>%
  dplyr::mutate( id = sub_id %>%
                  fct_recode("1" = "Aaron",
                             "2" = "Karen",
                             "3" = "Stuart",
                             "4" = "Jack",
                             "5" = "Eddie",
                             "6" = "Hank",
                             "7" = "Tommy",
                             "8" = "Alex",
                             "9" = "Donal",
                             "10" = "Jake",
                             "11" = "Sarah",
                             "12" = "Amanda",
                             "13" = "Kelly",
                             "14" = "Ricky",
                             "15" = "Scott",
                             "16" = "David",
                             "17" = "Ken",
                             "18" = "Matt",
                             "19" = "Carson",
                             "20" = "Colton",
```

```
                                "21" = "Owen")) %>%
  dplyr::mutate(phase = phase %>% forcats::fct_relevel("Baseline",
                                                       after = 0)) %>%
  dplyr::mutate(sub_dom = paste(sub_id, domain_name, sep = "_")) %>%
  dplyr::select(-day, -perc, -correct, -outof, -num_cor, -num_inc) %>%
  dplyr::group_by(study_id, sub_id, domain_name, dayc) %>%
  dplyr::mutate(score_per = mean(score_per)) %>%
  dplyr::slice(1) %>%
  dplyr::ungroup() %>%
  dplyr::mutate(sub_dom = paste(sub_id, domain_name, sep = ", "))
```

2.3 Long Format

One line per combination of study (n = 8), child (n = 21), and domain (aggregating all days/sessions), for a total of n = 531 lines of data.

```
data_es <- df_child_domain_day %>%
  dplyr::mutate(score_per = case_when(!is.na(outof) ~ correct/outof,
                                      is.na(outof) ~ perc)) %>%
  dplyr::mutate(num_cor = score_per * outof,
                num_inc = outof - correct) %>%
  dplyr::mutate(age_cat = cut(sub_age_years,
                              breaks = c(1, 6, 12),
                              include.lowest = TRUE) %>%
                forcats::fct_recode("Up to Six" = "[1,6]",
                                    "Over Six" = "(6,12]")) %>%
  dplyr::mutate(study_num = study_id  %>%
                fct_recode("1" = "Browder2017",
                           "2" = "Jowett2012",
                           "3" = "Keating2018",
                           "4" = "OBrien2018",
                           "5" = "Root2016",
                           "6" = "Root2019",
                           "7" = "Smith2013",
                           "8" = "Weng2014")) %>%
  dplyr::mutate( id = sub_id %>%
                  fct_recode("1" = "Aaron",
                             "2" = "Karen",
                             "3" = "Stuart",
                             "4" = "Jack",
                             "5" = "Eddie",
                             "6" = "Hank",
                             "7" = "Tommy",
                             "8" = "Alex",
                             "9" = "Donal",
                             "10" = "Jake",
                             "11" = "Sarah",
                             "12" = "Amanda",
                             "13" = "Kelly",
                             "14" = "Ricky",
                             "15" = "Scott",
                             "16" = "David",
                             "17" = "Ken",
                             "18" = "Matt",
                             "19" = "Carson",
                             "20" = "Colton",
```

```
                                "21" = "Owen")) %>%
  dplyr::mutate(phase = phase %>% forcats::fct_relevel("Baseline",
                                                       after = 0)) %>%
  dplyr::mutate(sub_dom = paste(sub_id, domain_name, sep = "_")) %>%
  dplyr::group_by(study_id, sub_id, domain_name, dayc) %>%
  dplyr::mutate(score_per = mean(score_per)) %>%
  dplyr::slice(1) %>%
  dplyr::ungroup()
```

2.4 Wide Format

One line per combination of study (n = 8), child (n = 21), and domain (aggregating all days/sessions), for a total of n = 28 lines of data.

2.5 Sample Size

```
df_clean %>%
  dplyr::group_by(study_id) %>%
  dplyr::mutate(n_sd = n_distinct(sub_dom)) %>%
  dplyr::group_by(study_id, id) %>%
  dplyr::slice(1) %>%
  dplyr::ungroup() %>%
  dplyr::group_by(study_id) %>%
  dplyr::mutate(n = n()) %>%
  dplyr::slice(1) %>%
  dplyr::arrange(study_id) %>%
  dplyr::select("Study Number" = study_num,
                "Study ID" = study_id,
                "Number of Students" = n,
                "Numer of Sub/Domain" = n_sd) %>%
  pander::pander(caption = "List of Studies and Corresponding Sample
                 Sizes for Analysis")
```

Table D.1
List of Studies and Corresponding Sample Sizes for Analysis

Study Number	Study ID	Number of Students	Numer of Sub/Domain
1	Browder2017	3	9
2	Jowett2012	1	1
3	Keating2018	3	3
4	OBrien2018	4	4
5	Root2016	1	2
6	Root2019	3	3
7	Smith2013	3	3
8	Weng2014	3	3

3 Illustrative Example 1: Browder 2017

This study included 3 children each measures on three different domains.

```
df_clean %>%
  dplyr::filter(study_id == "Browder2017") %>%
  dplyr::group_by(sub_id, domain_name) %>%
  dplyr::summarise(n_sess = n()) %>%
  tidyr::pivot_wider(names_from = domain_name,
                     values_from = n_sess) %>%
  dplyr::rename(Child = sub_id) %>%
  xtable::xtable (caption = "Study 1 (Bowder, 2017) Number of Session
                  for each Child on Each Domain") %>%
print(booktabs = TRUE,
        comment = FALSE,
        include.rownames = FALSE,
        caption.placement = "top")
```

Table D.2

Study 1 (Bowder, 2017) Number of Session for each Child on Each Domain

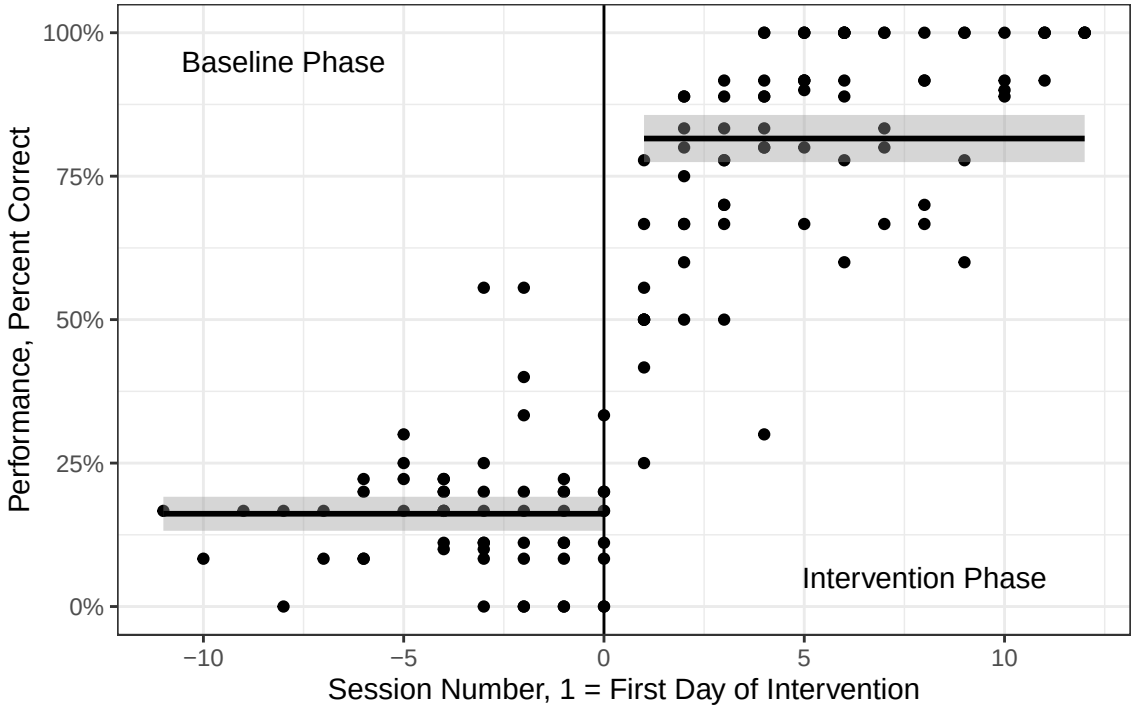
Child	Reading Comprehension	Story Element Definitions	Story Element Labels
Aaron	11	21	11
Karen	13	24	13
Stuart	17	13	17

3.1 Irrespect of Child and Domain

```
fig_study1_a <- df_clean %>%
  dplyr::filter(study_id == "Browder2017") %>%
  ggplot(aes(x = dayc,
             y = score_per)) +
  geom_point() +
  geom_smooth(aes(group = phase),
              color = "black",
              method = "lm",
              formula = (y ~ 1)) +
  geom_vline(xintercept = 0) +
  theme_bw() +
  labs(x = "Session Number, 1 = First Day of Intervention",
       y = "Performance, Percent Correct") +
  scale_y_continuous(labels = scales::percent) +
  annotate(geom = "text",
           label = "Baseline Phase",
           x = -8, y = .95)  +
  annotate(geom = "text",
           label = "Intervention Phase",
           x = 8, y = .05)

fig_study1_a +
  labs(caption = "Note: No time trend in either Phase")
```

Figure D.1

Performance in Study 1 (Bowder, 2017) Irrespect of Child and Domain



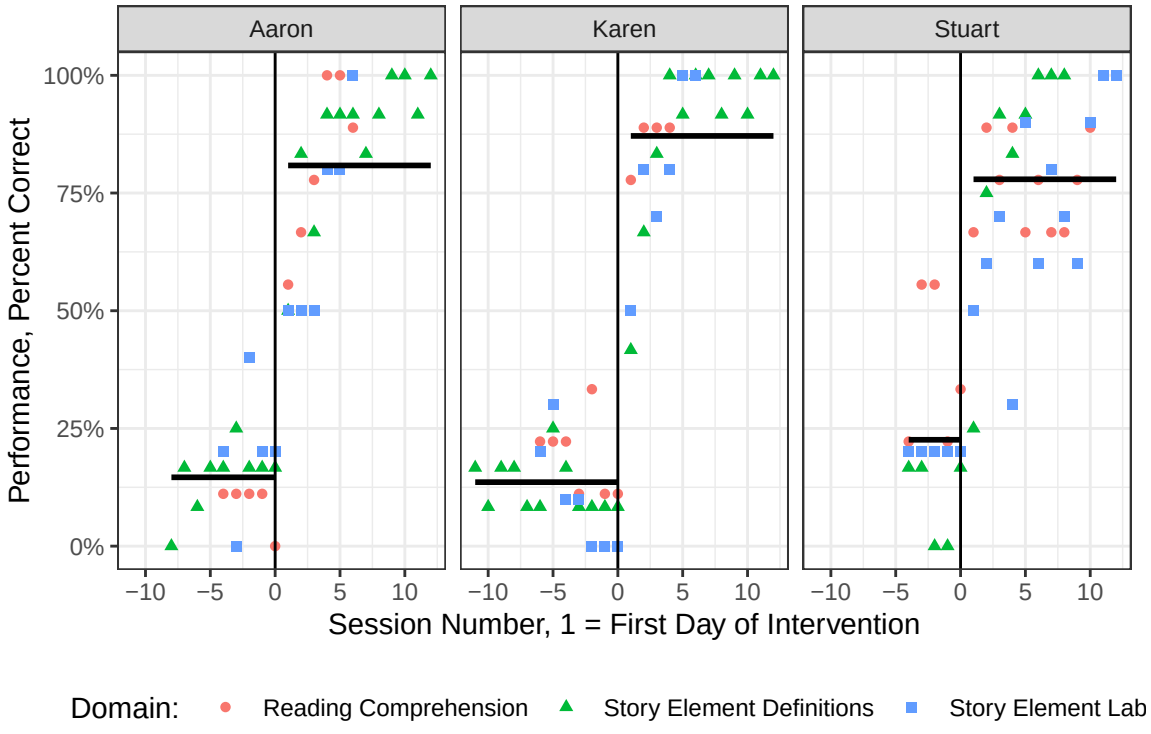
Note: No time trend in either Phase

3.2 Seperate for each Child, Denoting Domain

```
df_clean %>%
  dplyr::filter(study_num == "1") %>%
  ggplot(aes(x = dayc,
             y = score_per)) +
  geom_point(aes(color = domain_name,
                 shape = domain_name)) +
  geom_smooth(aes(group = phase),
              color = "black",
              method = "lm",
              se = FALSE,
              formula = (y ~ 1)) +
  geom_vline(xintercept = 0) +
  theme_bw() +
  facet_grid(~ sub_id)  +
  labs(x = "Session Number, 1 = First Day of Intervention",
       y = "Performance, Percent Correct",
       color = "Domain: ",
       shape = "Domain: ") +
  scale_y_continuous(labels = scales::percent) +
  theme(legend.position = "bottom")
```

Figure D.2

Performance in Study 1 (Bowder, 2017) Seperated by Child and Domain

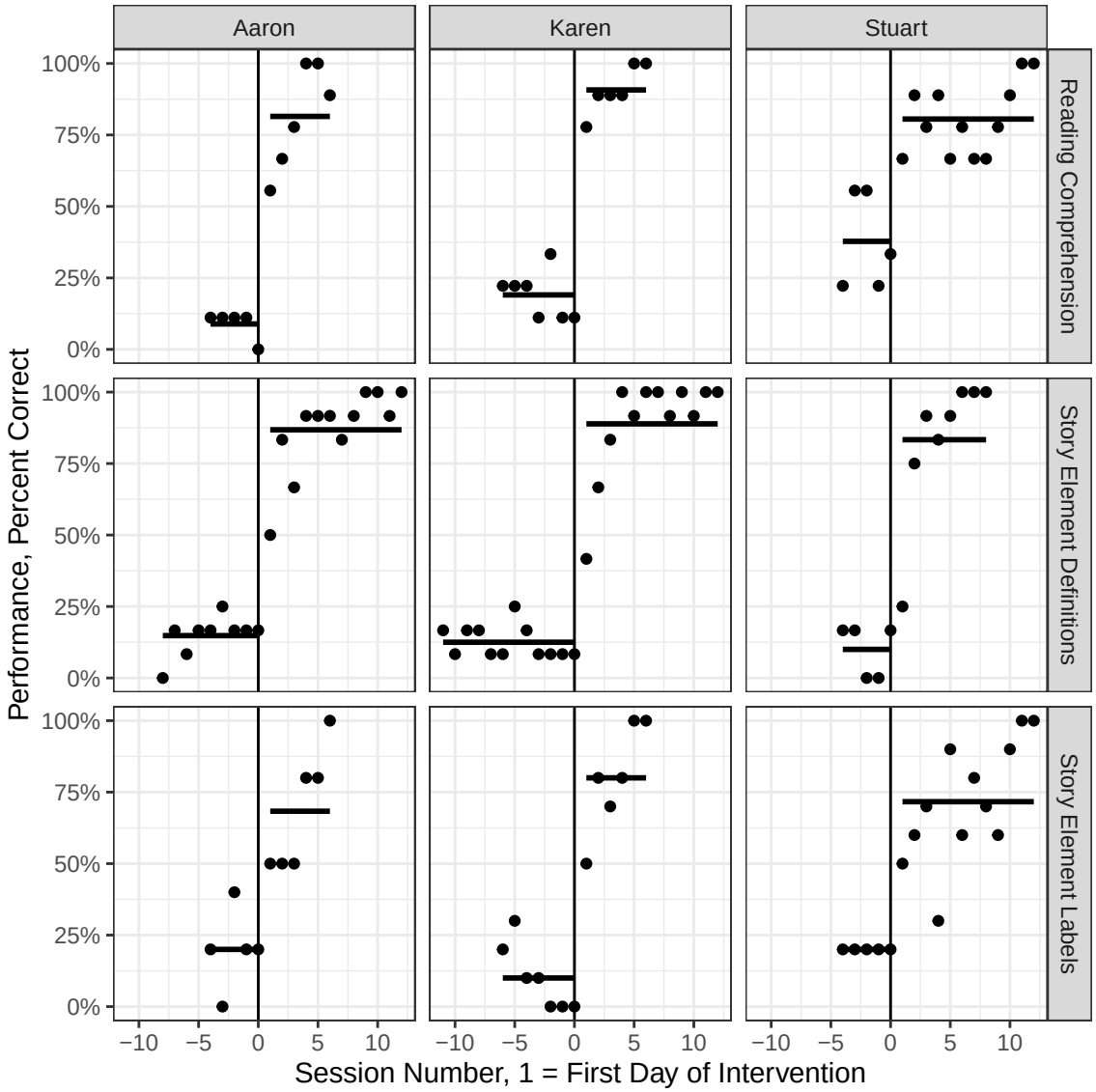


3.3 Seperate for each Child and Domain Combination

```
df_clean %>%
  dplyr::filter(study_num == "1") %>%
  ggplot(aes(x = dayc,
             y = score_per)) +
  geom_point() +
  geom_smooth(aes(group = phase),
              color = "black",
              method = "lm",
              se = FALSE,
              formula = (y ~ 1)) +
  geom_vline(xintercept = 0) +
  theme_bw() +
  facet_grid(domain_name ~ sub_id) +
  labs(x = "Session Number, 1 = First Day of Intervention",
       y = "Performance, Percent Correct",
       color = "Domain: ") +
  scale_y_continuous(labels = scales::percent)
```

Figure D.3

Performance in Study 1 (Browder, 2017) by Child and Domain



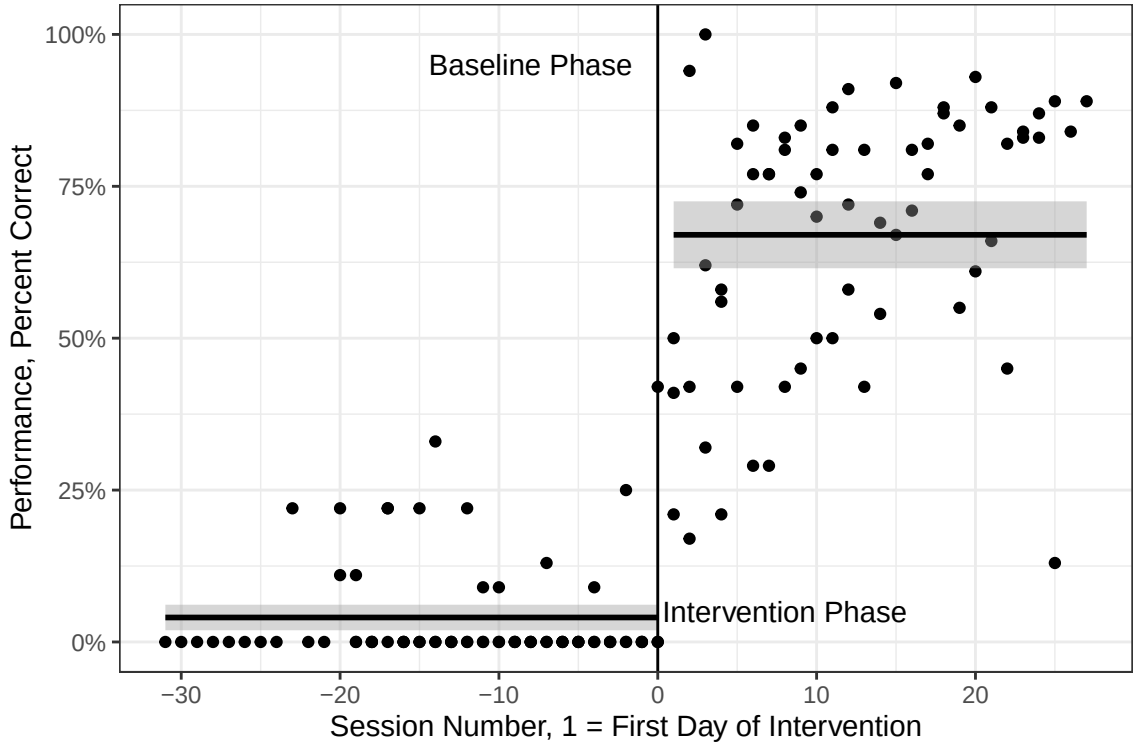
4 Illustrative Example 2: Keating 2018

4.1 Irrespect of Child and Domain

```
df_clean %>%
  dplyr::filter(study_num == "3") %>%
  ggplot(aes(x = dayc,
             y = score_per/100)) +
  geom_point() +
  geom_smooth(aes(group = phase),
              color = "black",
              method = "lm",
              formula = (y ~ 1)) +
  geom_vline(xintercept = 0) +
  theme_bw() +
  labs(x = "Session Number, 1 = First Day of Intervention",
       y = "Performance, Percent Correct") +
  scale_y_continuous(labels = scales::percent) +
  annotate(geom = "text",
           label = "Baseline Phase",
           x = -8, y = .95)  +
  annotate(geom = "text",
           label = "Intervention Phase",
           x = 8, y = .05)
```

Figure D.4

Performance in Study 3 (Keating, 2018) Irrespect of Child and Domain

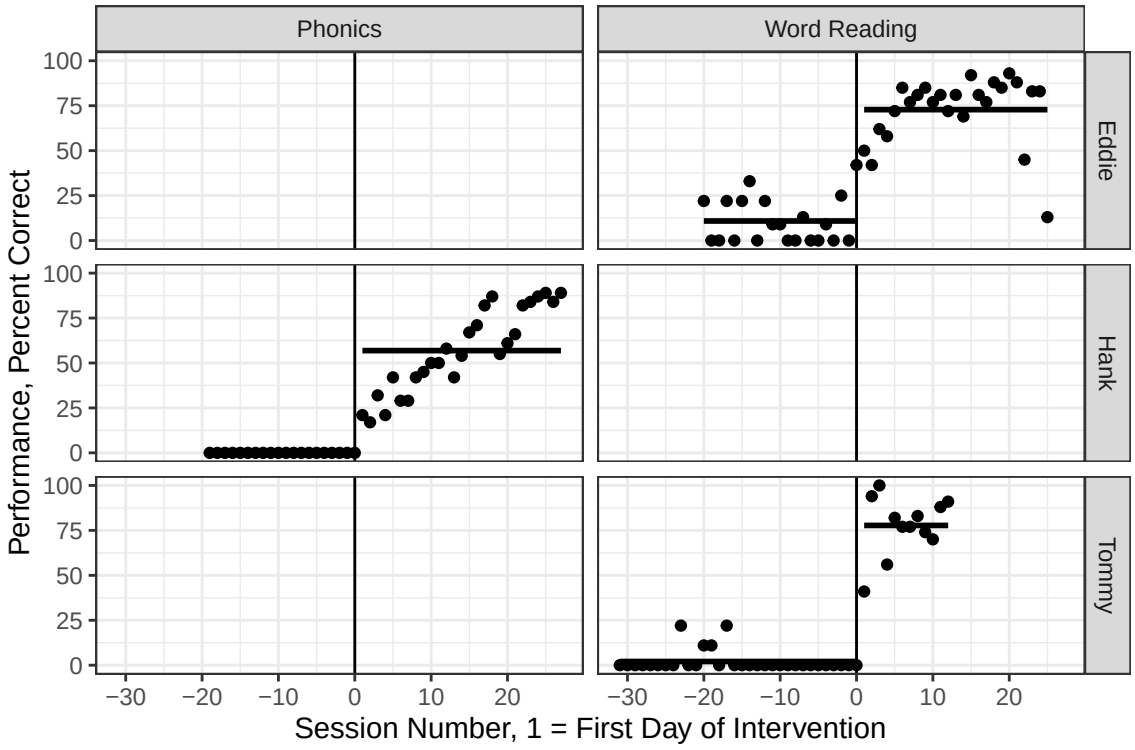


4.2 Seperate for each Child, Denoting Domain

```
df_clean %>%
  dplyr::filter(study_num == "3") %>%
  ggplot(aes(x = dayc,
             y = score_per)) +
  geom_point() +
  geom_smooth(aes(group = phase),
              color = "black",
              method = "lm",
              se = FALSE,
              formula = (y ~ 1)) +
  labs(x = "Session Number, 1 = First Day of Intervention",
       y = "Performance, Percent Correct") +
  geom_vline(xintercept = 0) +
  theme_bw() +
  facet_grid(sub_id~domain_name)
```

Figure D.5

Performance in Study 3 (Keating, 2018) Seperated by Child and Domain

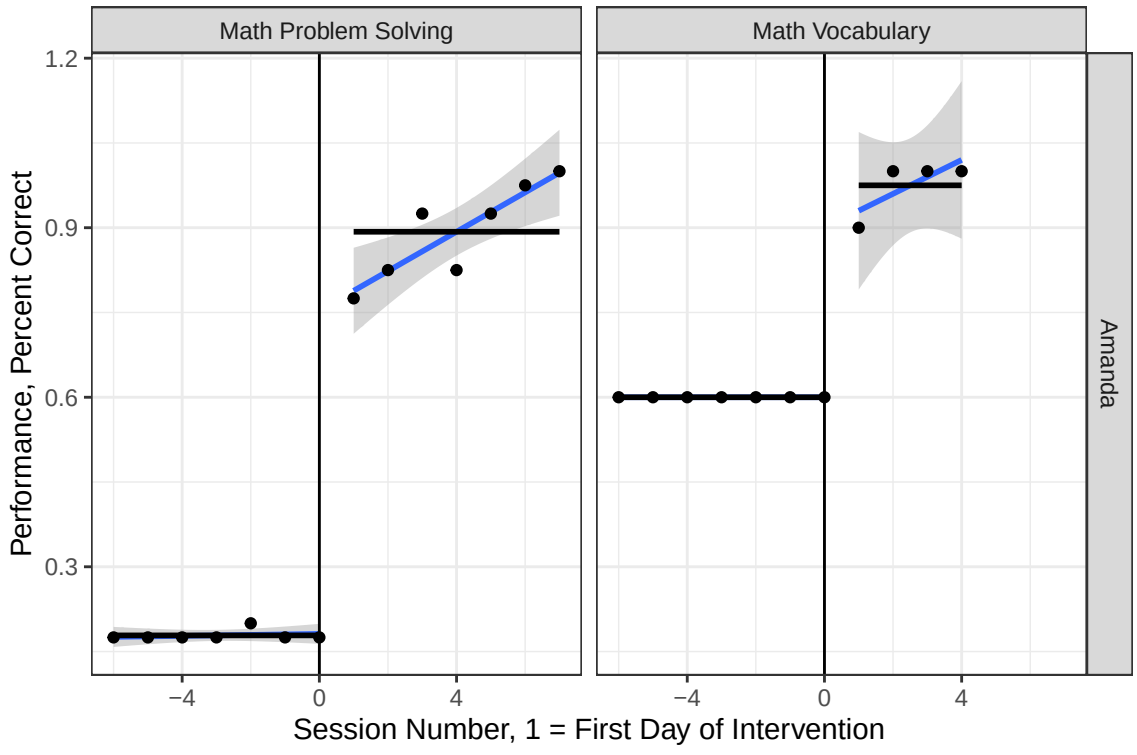


4.3 Individual Outcome for Study 3 (Keating, 2018)

```
df_clean %>%
  dplyr::filter(study_id == "Root2016") %>%
  ggplot(aes(x = dayc,
             y = score_per)) +
  geom_smooth(aes(group = phase),
              method = "lm") +
  geom_point() +
  geom_smooth(aes(group = phase),
              color = "black",
              method = "lm",
              se = FALSE,
              formula = (y ~ 1)) +
   labs(x = "Session Number, 1 = First Day of Intervention",
        y = "Performance, Percent Correct") +
  geom_vline(xintercept = 0) +
  theme_bw() +
  facet_grid(sub_id~domain_name)
```

Figure D.6

Visualize Performance in Root, 2016 Seperated by Child and Domain



5 BC-SMD, Method of Moments

n = 7 studies, since study 2 (Jowett, 2012) is removed due to having a single child with a single domain

5.1 Calculate for Each Study

```
data_bcsmd_un <- df_clean %>%
  dplyr::filter(study_num != "2") %>%
  dplyr::group_by(study_num) %>%
  dplyr::mutate(n_sub = n_distinct(id)) %>%
  dplyr::group_by(study_num, study_id, n_sub) %>%
  tidyr::nest() %>%
  dplyr::mutate(fit  = purrr::map(data, bc_smd)) %>%
  dplyr::mutate(tidy = purrr::map(fit, broom::tidy)) %>%
  tidyr::unnest(tidy) %>%
  dplyr::select(-data, -fit) %>%
  tidyr::pivot_wider(names_from  = names,
                     values_from = x)
```

```
data_bcsmd_un %>%
  dplyr::ungroup() %>%
  dplyr::arrange(study_id) %>%
  dplyr::select("Study Citation" = study_id,
                "Subjects"       = n_sub,
                "Observations"   = g_dotdot,
                "Estimate"       = delta_hat,
                "Variance"       = V_delta_hat) %>%
  xtable::xtable(digits = c(0, 0, 0, 0, 3, 3),
                 align = c("l", "l", "c", "c", "r", "r"),
                 caption = "Design Comparable Effect Sizes: BC-SMD,
                 Momemt Estimation Method (assumes no
                 time trend during baseline
                 or intervention phases)") %>%
  print(booktabs = TRUE,
        comment = FALSE,
        include.rownames = FALSE,
        caption.placement = "top")
```

Table D.3

Design Comparable Effect Sizes: BC-SMD, Momemt Estimation Method (assumes no time trend during baseline or intervention phases)

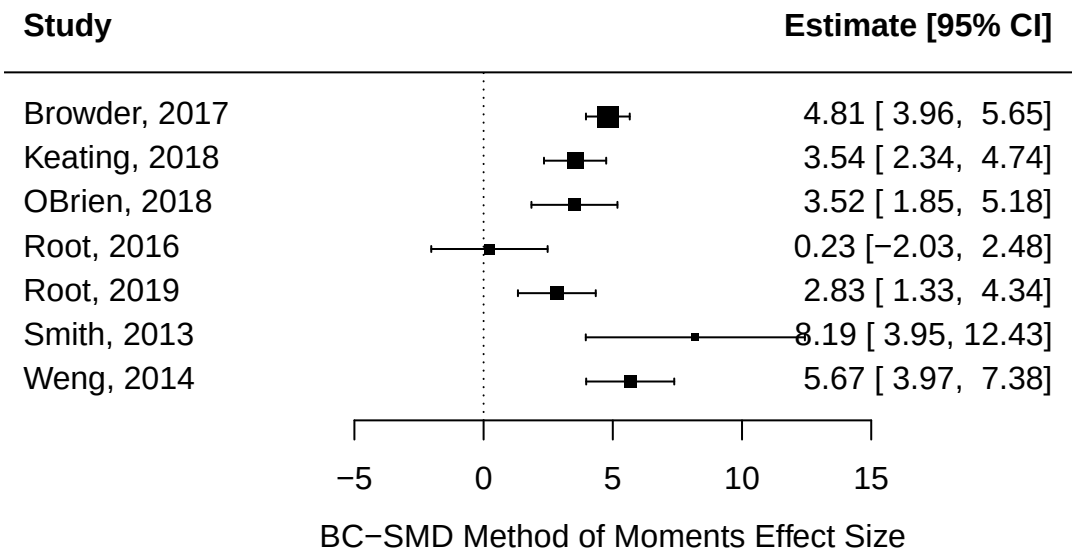
Study Citation	Subjects	Observations	Estimate	Variance
Browder2017	3	140	4.808	0.187
Keating2018	3	137	3.540	0.377
OBrien2018	4	57	3.515	0.721
Root2016	1	25	0.226	1.320
Root2019	3	34	2.834	0.590
Smith2013	3	27	8.193	4.678
Weng2014	3	45	5.673	0.755

5.2 Pool All Studies

5.3 Forest Plot

```
data_bcsmd_un %>%
  dplyr::mutate(study_lab = paste0(stringr::str_sub(study_id,
                                                    end = -5),
                                   ", ",
                                   stringr::str_sub(study_id,
                                                    start = -4))) %>%
  metafor::forest(x = .$delta_hat,
                  vi = .$V_delta_hat,
                  slab = .$study_lab,
                  xlab = "BC-SMD Method of Moments Effect Size",
                  header = TRUE)
```

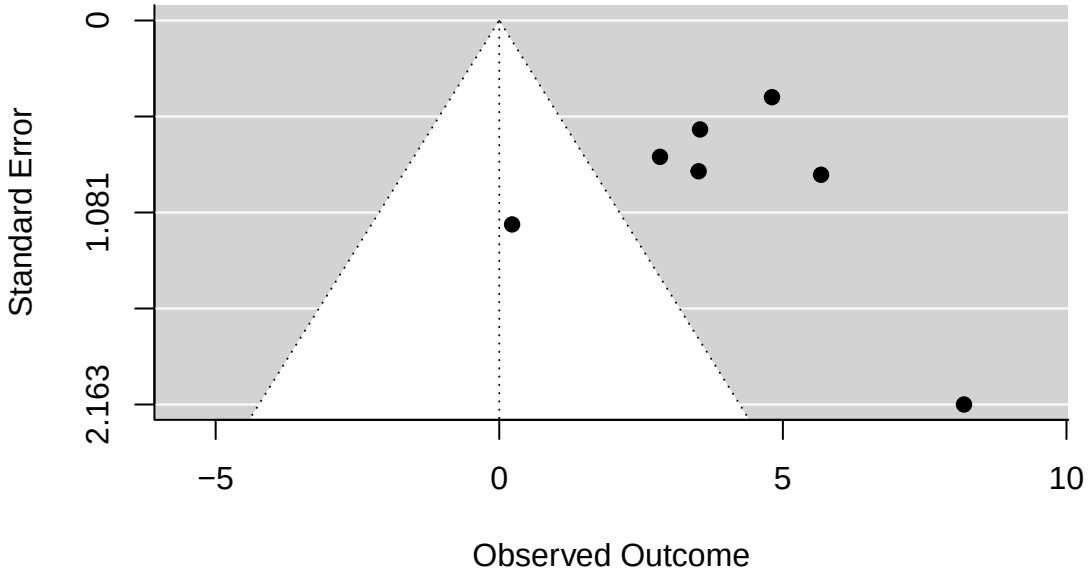
Figure D.7
Forest Plot for Study-Pooled BC-SMD Effect Size



5.4 Funnel Plot

```
metafor::funnel(x = data_bcsmd_un$delta_hat,
                vi = data_bcsmd_un$V_delta_hat,
                ni = data_bcsmd$g_dotdot)
```

Figure D.8
Funnel Plot for Study-Pooled BC-SMD Effect Size



5.5 MLM for each Study: Regress Performance on session within phase

Allow for a time trend in BOTH the baseline and intervention phases!

> *Note:* Exclude Study 2 (Jowett, 2012) which only incuded a single child (Jack) on a single domain (numeracy).

```
fit_test <-  df_clean %>%
  dplyr::filter(study_num != "2") %>%
  dplyr::group_by(study_id) %>%
  dplyr::mutate(g_dotdot = n()) %>%
  dplyr::mutate(n_sub = n_distinct(sub_id)) %>%
  dplyr::mutate(n_sub_dom = n_distinct(sub_dom)) %>%
  dplyr::group_by(study_num, study_id, n_sub_dom, n_sub, g_dotdot) %>%
  tidyr::nest_legacy() %>%
  dplyr::mutate(mlm = map(data,
                          ~nlme::lme(fixed  = score_per ~  -1 + phase
                                     + phase:dayc,
                                     random =  ~ 1 |sub_dom,
                                     correlation = corAR1
                                     (0, ~ dayc|sub_dom),
                                     data = data.frame(.))))
```

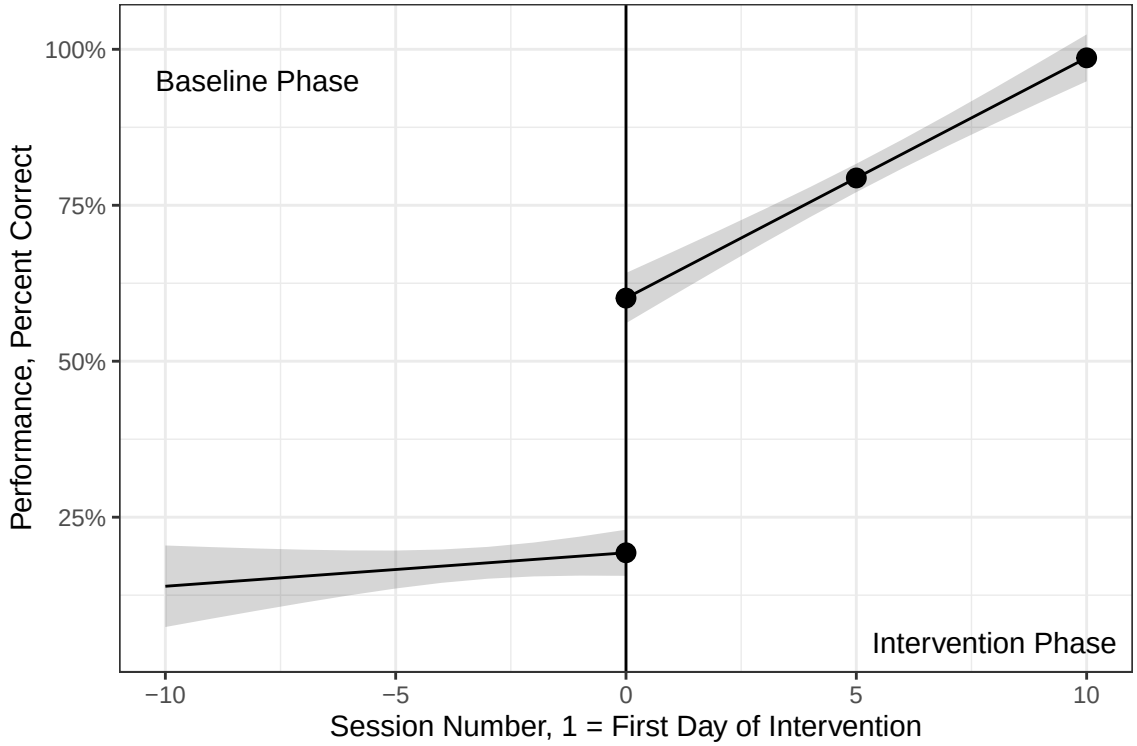
5.5.1 Example: MLM for Study 1 (Bowder, 2017)

- Fixed effects (beta parameters): 4 = 2 intercepts (BL & Int) and 2 slopes (BL and Int)
- Random effects (variance components): 3 = 1 random intercepts, 1 residuals, 1 auto-regressive correlation

```
nlme::lme(fixed  = score_per ~  -1 + phase + phase:dayc,
          random =  ~ 1 |sub_dom,
          correlation = corAR1(0, ~ dayc|sub_dom),
          data = df_clean %>%
            dplyr::filter(study_id == "Browder2017")) %>%
  effects::Effect(focal.predictors = c("phase", "dayc"),
                  mod = .,
                  xlevels = list(dayc = -10:10)) %>%
  data.frame() %>%
  dplyr::filter( (phase == "Baseline" & dayc <= 0) |
                   (phase == "App_Intervention" & dayc >= 0)) %>%
  ggplot(aes(x = dayc,
             y = fit,
             group = phase)) +
  geom_ribbon(aes(ymin = fit - se,
                  ymax = fit + se),
              alpha = .2) +
  geom_line() +
  theme_bw() +
  geom_point(data = . %>% filter(dayc %in% c(0, 5, 10)),
             size = 3) +
  geom_vline(xintercept = 0) +
  labs(x = "Session Number, 1 = First Day of Intervention",
       y = "Performance, Percent Correct") +
  scale_y_continuous(labels = scales::percent) +
  annotate(geom = "text",
           label = "Baseline Phase",
           x = -8, y = .95)  +
  annotate(geom = "text",
           label = "Intervention Phase",
           x = 8, y = .05)
```

Figure D.9

Illustration of MLM for BC-SMD for Study 1 (Bowder, 2017)



Design-Comparable Effect Size

Estimates a standardized mean difference effect size from a fitted multi-level model, using restricted or full maximum likelihood methods with small-sample correction, as described in Pustejovsky, Hedges, & Shadish (2014).

> *Note:* Pustejovsky, J. E., Hedges, L. V., & Shadish, W. R. (2014). Design-comparable effect sizes in multiple baseline designs: A general modeling framework. Journal of Educational and Behavioral Statistics, 39(4), 211-227. doi:10.3102/1076998614547577

- `p_const` Vector of constants for calculating **numerator** of effect size, length equals the number of **fixed parameters** in the model
- `r_const` Vector of constants for calculating **denominator** of effect size, length equals the number of **variance components** in the model

```
scdhlm::g_mlm(magrittr::extract2(fit_test$mlm[1],1),
              p_const = c(-1, 1, 0, 5),
              r_const = c(1, 0, 1),
              returnModel = FALSE)
```

```
                         est    se
unadjusted effect size  4.304 0.431
adjusted effect size    4.268 0.428
degree of freedom      90.643
```

```
scdhlm::g_mlm(magrittr::extract2(fit_test$mlm[1],1),
              p_const = c(-1, 1, 0, 10),
              r_const = c(1, 0, 1),
              returnModel = FALSE)
```

```
                         est    se
unadjusted effect size  5.683 0.581
adjusted effect size    5.636 0.577
degree of freedom      90.643
```

6 BC-SMD, REML Adjusted

n = 7 studies, since study 2 (Jowett, 2012) is removed due to having a single child with a single domain

- g_AB Corrected effect size estimate
- r_theta Squared denominator of effect size
- SE_g_AB Approximate standard error estimate
- theta Estimated variance component parameters

6.1 Calculate for Each Study

```
data_bcsmd <- df_clean %>%
  dplyr::filter(study_num != "2") %>%
  dplyr::group_by(study_id) %>%
  dplyr::mutate(g_dotdot = n()) %>%
  dplyr::mutate(n_sub = n_distinct(sub_id)) %>%
  dplyr::mutate(n_sub_dom = n_distinct(sub_dom)) %>%
  dplyr::group_by(study_num, study_id, n_sub_dom, n_sub, g_dotdot) %>%
  tidyr::nest_legacy() %>%
  dplyr::mutate(mlm = map(data,
                          ~nlme::lme
                          (fixed  = score_per ~ -1 + phase
                            + phase:dayc,
                                    random =  ~ 1 |sub_dom,
                                    correlation = corAR1
                            (0, ~ dayc|sub_dom),
                                    data = data.frame(.)))) %>%
  dplyr::mutate(fit_g = purrr::map(mlm,
                                   ~scdhlm::g_mlm(.,
                                  p_const = c( -1, 1, 0, 5),
                                  r_const = c(1, 0, 1),
                                  returnModel = FALSE))) %>%
  dplyr::mutate(test = purrr::map(fit_g, ~extract_g(.))) %>%
  tidyr::unnest_wider(
    test,
    simplify = TRUE,
    strict = FALSE,
    names_repair = "check_unique",
    ptype = NULL,
    transform = NULL)
```

6.2 Calculate for No Time Trend

```
data_bcsmd %>%
  dplyr::ungroup() %>%
  dplyr::arrange(study_id) %>%
  dplyr::select("Study Citation" = study_id,
                "Subjects"       = n_sub,
                "Observations"   = g_dotdot,
                "Estimate"       = g_AB,
                "SE"       = SE_g_AB) %>%
  xtable::xtable(digits = c(0, 0, 0, 0, 3, 3),
                 align = c("l", "l", "c", "c", "r", "r"),
                 caption = "Design Comparable Effect Size: BC-SMD,
                 REML Estimation
                 Method (no time trend during baseline but a time
                 trend
                 during intervention - after 5 sessions)") %>%
  print(booktabs = TRUE,
        comment = FALSE,
        include.rownames = FALSE,
        caption.placement = "top")
```

Table D.4

Design Comparable Effect Size: BC-SMD, REML Estimation Method (no time trend during baseline but a time trend during intervention - after 5 sessions)

Study Citation	Subjects	Observations	Estimate	SE
Browder2017	3	140	4.268	0.428
Keating2018	3	137	2.712	0.495
OBrien2018	4	57	2.283	0.799
Root2016	1	25	0.979	17.505
Root2019	3	34	4.028	1.331
Smith2013	3	27	10.361	1.732
Weng2014	3	45	7.040	0.964

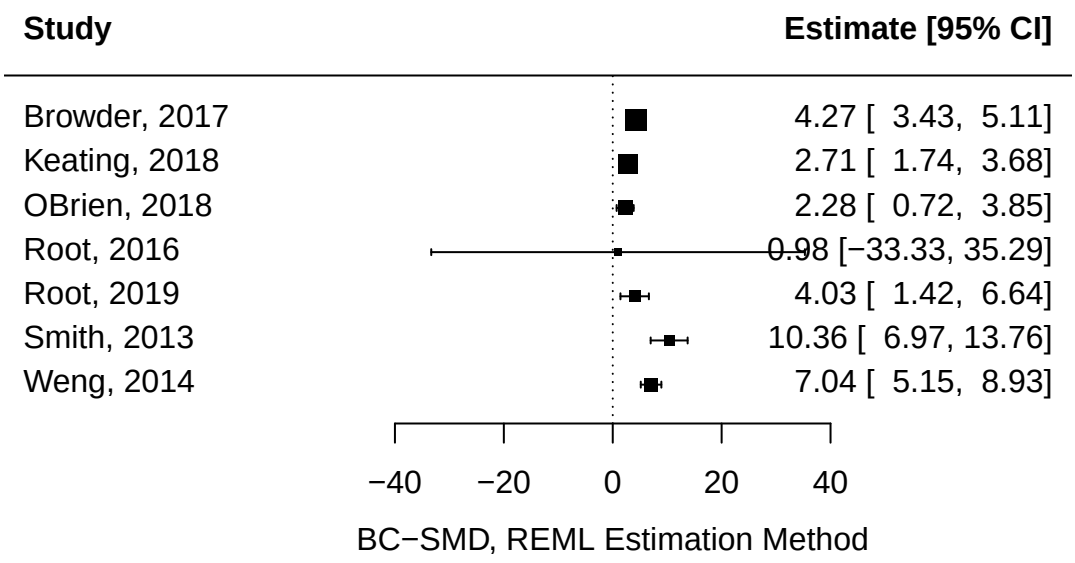
6.3 Pool All Studies

6.4 Forest Plot

Note: Assumes time trend during baseline phase, seperate from the time trend during intervention phase - after 5 days intervention.

```
ext <- data_bcsmd %>%
  dplyr::mutate(study_lab = paste0(stringr::str_sub(study_id,
                                                    end = -5),
                                   ", ",
                                   stringr::str_sub(study_id,
                                                    start = -4))) %>%
  dplyr::select(study_lab, g_AB, SE_g_AB)


metafor::forest(x = ext$g_AB,
                sei = ext$SE_g_AB,
                slab = ext$study_lab,
                xlab = "BC-SMD, REML Estimation Method",
                header = TRUE)
```

Figure D.10
Forest Plot of Design Comparable Effect Sizes After 5 Sessions: BC-SMD, REML Estimation Method



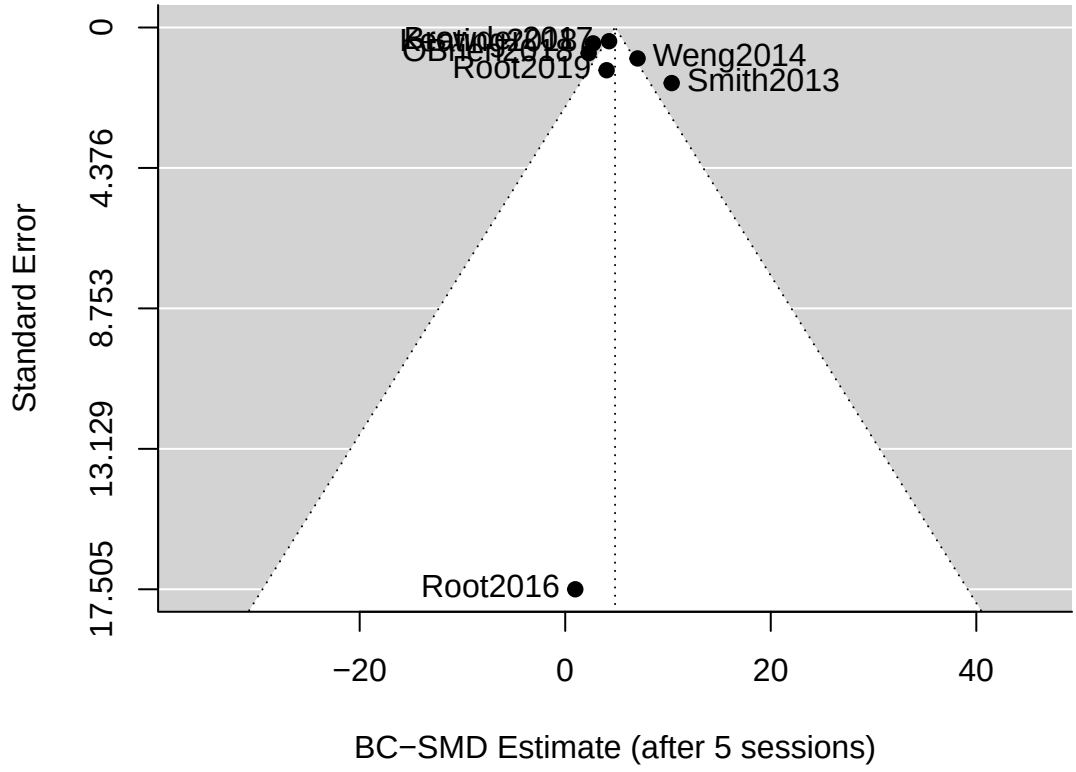
```r
data_bcsmd %>%
  metafor::rma(yi = g_AB,
               sei = SE_g_AB,
               data = .,
               slab = study_id)
```

```
Random-Effects Model (k = 7; tau^2 estimator: REML)

tau^2 (estimated amount of total heterogeneity): 6.5458 (SE = 4.7656)
tau (square root of estimated tau^2 value):      2.5585
I^2 (total heterogeneity / total variability):   90.97%
H^2 (total variability / sampling variability):  11.07

Test for Heterogeneity:
Q(df = 6) = 35.1638, p-val < .0001

Model Results:

estimate      se    zval    pval   ci.lb   ci.ub
  4.8503  1.1201  4.3302  <.0001  2.6549  7.0457  ***

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

6.5 Funnel Plot

```
metafor::rma(yi   = g_AB,
             sei   = SE_g_AB,
             data = data_bcsmd ,
             slab = study_id) %>%
  metafor::funnel(xlab = "BC-SMD Estimate (after 5 sessions)",
                  label = TRUE)
```

Figure D.11
Publication Bias: Funnel Plot, BC-SMD (REML based)




```
tiff(filename = "Funnelplot_bcSMD.tiff",
     res = 800,
     width = 6,
     height = 5,
     units = "in")
```

6.6 Regression Test for Funnel Plot Asymmetry

> "All of the tests do not directly test for publication bias, but for a relationship between the observed effect sizes or outcomes and the chosen predictor. If such a relationship is present, then this usually implies asymmetry in the funnel plot, which in turn may be an indication of publication bias. However, it is important to keep in mind that there can be other reasons besides publication bias that could lead to asymmetry in the funnel plot." -Wolfgang Viechtbauer
>
> Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. Journal of Statistical Software, 36(3), 1–48. https://doi.org/10.18637/jss.v036.i03

```
metafor::regtest(x   = g_AB,
                 sei   = SE_g_AB,
                 ni = n_sub_dom,
                 model = "rma",
                 data = data_bcsmd )
```

```
Regression Test for Funnel Plot Asymmetry

Model:     mixed-effects meta-regression model
Predictor: standard error

Test for Funnel Plot Asymmetry: z = 0.5021, p = 0.6156
Limit Estimate (as sei -> 0):   b = 4.3594 (CI: 1.5737, 7.1451)
```

```
data_lrr <- data_es %>%
  dplyr::filter(sub_id != "Hank") %>%
  dplyr::arrange(study_id, id, phase, dayc) %>%
  dplyr::mutate(sub_dom = paste(sub_id, domain_name, sep = ", ")) %>%
  SingleCaseES::batch_calc_ES(grouping       = c(study_id, sub_dom),
                              condition      = phase,
                              outcome        = score_per,
                              session_number = dayc,
                              baseline_phase = "Baseline",
                              ES             = "LRRi",
                              improvement    = "increase",
                              scale          = "proportion",
                              interval       = outof,
                              bias_correct   = TRUE,
                              confidence     = .95) %>%
  dplyr::left_join(data_wide, by = "sub_dom")
```

```
meta_d <- data_lrr %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ 1,
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .)
```

The p-values and confidence intervals here use the z-distrubution (assume large sample)

```
summary(meta_d)
```

```
Multivariate Meta-Analysis Model (k = 27; method: REML)

  logLik  Deviance       AIC       BIC      AICc
-30.8818   61.7636   67.7636   71.5379   68.8545

Variance Components:

            estim    sqrt  nlvls  fixed    factor
sigma^2.1  0.6840  0.8271      8     no  study_id
sigma^2.2  0.2419  0.4919     27     no   sub_dom

Test for Heterogeneity:
Q(df = 26) = 897.7972, p-val < .0001

Model Results:

estimate      se    zval    pval   ci.lb   ci.ub
  1.6900  0.3194  5.2918  <.0001  1.0641  2.3160  ***

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
meta_d %>%
  clubSandwich::coef_test(vcov = "CR2",
                          test = "Satterthwaite") %>%
  data.frame() %>%
  dplyr::mutate(expb = exp(beta),
                CI_L     = beta - SE * qt(0.975, df = df_Satt),
                CI_U     = beta + SE * qt(0.975, df = df_Satt),
                per_change_est = 100*(exp(beta) - 1),
                per_change_95l = 100*(exp(CI_L) - 1),
                per_change_95u = 100*(exp(CI_U) - 1)) %>%
  dplyr::select(beta, expb,
                per_change_est,
                per_change_95l,
                per_change_95u)
```

```
            beta     expb per_change_est per_change_95l per_change_95u
intrcpt 1.690043 5.419716       441.9716       155.2571       1050.735
```

```
meta_d
```

```
Multivariate Meta-Analysis Model (k = 27; method: REML)

Variance Components:

            estim    sqrt  nlvls  fixed    factor
sigma^2.1  0.6840  0.8271      8     no  study_id
sigma^2.2  0.2419  0.4919     27     no   sub_dom

Test for Heterogeneity:
Q(df = 26) = 897.7972, p-val < .0001

Model Results:

estimate      se    zval    pval   ci.lb   ci.ub
  1.6900  0.3194  5.2918  <.0001  1.0641  2.3160  ***

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
with(meta_d, b[[1]] + c(-1,1) * sqrt(sigma2[1]))
```

```
[1] 0.8629775 2.5171093
```

```
with(meta_d, exp(b[[1]] + c(-1,1) * sqrt(sigma2[1])) - 1)
```

```
[1]  1.370207 11.392721
```

6.6.1 Overall

```
data_lrr %>%
  summarise(studies = n_distinct(study_id),
            cases = n()) %>%
  pander::pander(caption ="Number of Studies and Cases for LRR-i")
```

Table D.5
Number of Studies and Cases for LRR-i

studies	cases
8	27

7 Effect Moderators

7.1 Race

```
data_lrr %>%
  group_by(race) %>%
  summarise(studies = n_distinct(study_id),
            cases = n()) %>%
  pander::pander(caption = "List of Studies and Cases for Race")
```

Table D.6
List of Studies and Cases for Race

race	studies	cases
American Indian or Alaska Native	1	1
Black or African American	1	1
Hispanic, Latino or Spanish Origin	1	3
Multi	1	2
Native Hawaiian or Other Pacific Islander	1	1
White	5	14
NA	2	5

```
meta_d_race <- data_lrr %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ 0 + I(race == "White"),
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .)
```

```
meta_regress_table(meta_d_race,
                   replace = c("non-White", "White"),
                   cap = "Test for Moderators: Percent Increase in
                   LRRi for
                   Ethnicity")
```

Table D.7

Test for Moderators: Percent Increase in LRRi for Ethnicity

Term	Beta	expB	Percent Increase	Lower 95 CI	Upper 95 CI	Sig.
non-White	1.19	3.30	230	16	840	0.035
White	1.45	4.26	326	123	713	0.003

7.2 Age in Years

```
data_lrr %>%
  dplyr::filter(complete.cases(sub_age_years)) %>%
  dplyr::summarise(studies = n_distinct(study_id),
                   cases = n()) %>%
  pander::pander(caption ="List of Studies and Cases for Age in
                 Years")
```

Table D.8
List of Studies and Cases for Age in Years

studies	cases
8	27

```
meta_d_age <- data_lrr %>%
  dplyr::filter(complete.cases(sub_age_years)) %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ 1 + I(sub_age_years-6),
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .)
```

```
meta_regress_table(meta_d_age,
                   replace = c("Age 6","Years"),
                   cap = "Test for Moderators: Percent Increase in
                   LRRi for Age,
                   years from 12")
```

Table D.9

Test for Moderators: Percent Increase in LRRi for Age, years from 12

Term	Beta	expB	Percent Increase	Lower 95 CI	Upper 95 CI	Sig.
Age 6	2.32	10.14	914	302	2454	0.005
Years	-0.23	0.80	-20	-33	-5	0.025

7.3 Age Split at 6 Years

```
data_lrr %>%
  dplyr::filter(complete.cases(age_cat)) %>%
  group_by(age_cat) %>%
  summarise(studies = n_distinct(study_id),
            cases = n()) %>%
  pander::pander(caption ="List of Studies and Cases for Age in years
                 Up to Six
                 and Over Six")
```

Table D.10
List of Studies and Cases for Age in years Up to Six and Over Six

age_cat	studies	cases
Up to Six	3	7
Over Six	5	20

```
meta_d_age_cat <- data_lrr %>%
  dplyr::filter(complete.cases(age_cat)) %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ 0 + age_cat,
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .)
```

```
meta_regress_table(meta_d_age_cat,
                   cut = "age_cat",
                   cap = "Test for Moderators: Percent Increase in
                   LRRi for Age,
                   over or under 12")
```

Table D.11

Test for Moderators: Percent Increase in LRRi for Age, over or under 12

Term	Beta	expB	Percent Increase	Lower 95 CI	Upper 95 CI	Sig.
Up to Six	2.71	14.98	1398	63	13643	0.034
Over Six	1.21	3.35	235	111	433	0.002

7.4 Diagnosis

```
data_lrr %>%
  dplyr::filter(complete.cases(sub_dx)) %>%
  dplyr::group_by(sub_dx) %>%
  summarise(studies = n_distinct(study_id),
            cases = n()) %>%
  pander::pander(caption = "List of Studies and Cases for Diagnosis")
```

Table D.12
List of Studies and Cases for Diagnosis

sub_dx	studies	cases
Autism	7	20
Autism and Speech-Language Impairment	1	1
Autism and ADHD	1	1
Autism and Intellectual Disability	2	3
Autism and Other	1	2

```
meta_d_dx <- data_lrr %>%
  dplyr::filter(complete.cases(sub_dx)) %>%
  dplyr::mutate(sub_dx2 = ifelse(sub_dx == "Autism", "ASD Only",
                                 "ASD Plus")) %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ 0 + sub_dx2,
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .)
```

```
meta_regress_table(meta_d_dx ,
                   cut = "sub_dx2",
                   cap = "Test for Moderators: Percent Increase in
                   LRRi for
                   Diagnosis")
```

Table D.13
Test for Moderators: Percent Increase in LRRi for Diagnosis

Term	Beta	expB	Percent Increase	Lower 95 CI	Upper 95 CI	Sig.
ASD Only	1.72	5.56	456	130	1245	0.003
ASD Plus	1.64	5.17	417	114	1152	0.006

7.5 Study Quality Based on WWC

```
data_lrr %>%
  dplyr::filter(complete.cases(wwc_study)) %>%
  dplyr::group_by(wwc_study) %>%
  summarise(studies = n_distinct(study_id),
            cases = n()) %>%
  pander::pander(caption ="List of Studies and Cases for Study
                 Quality Based on
                 WWC")
```

Table D.14
List of Studies and Cases for Study Quality Based on WWC

wwc_study	studies	cases
Meets Fully	3	8
Meets with Reservations	2	5
Does Not Meet	3	14

```
meta_d_wwc <- data_lrr %>%
  dplyr::filter(complete.cases(wwc_study)) %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ 0 + wwc_study,
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .)
```

8 Publication Bias

https://bookdown.org/MathiasHarrer/Doing_Meta_Analysis_in_R/pub-bias.html

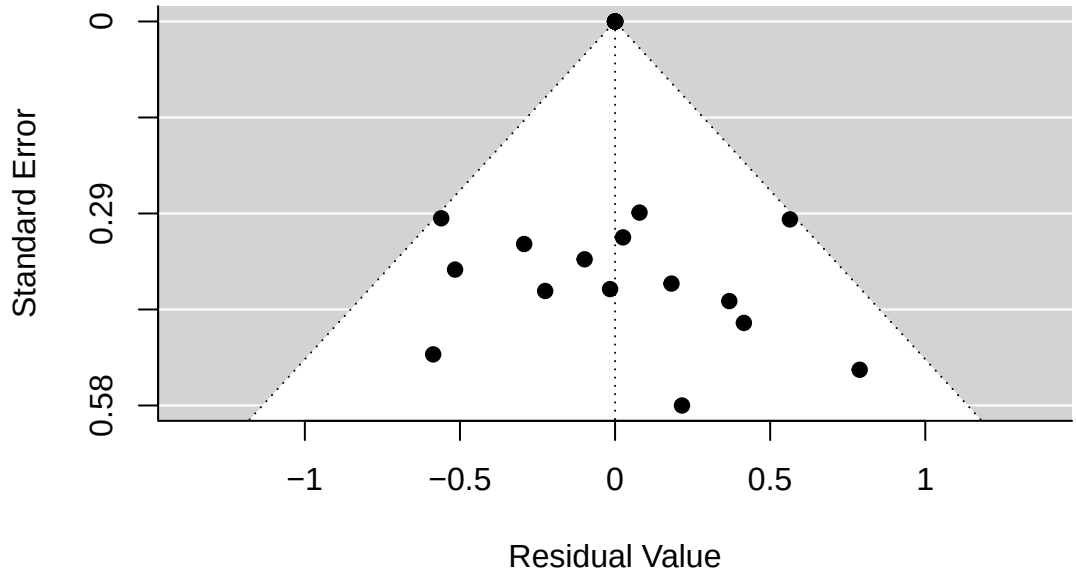
Section 9.2.1.1 The Funnel Plot

Section 4.2

8.1 All Moderators Funnel Plot

```
data_lrr %>%
  dplyr::mutate(var = SE^2) %>%
  metafor::rma.mv(Est ~ race + age_cat + sub_dx + wwc_study,
                  V = var,
                  random = list(~ 1 | study_id,
                                ~ 1 | sub_dom),
                  data = .) %>%
  metafor::funnel()
```

Figure D.12
Publication Bias Funnel Plot with All Moderators



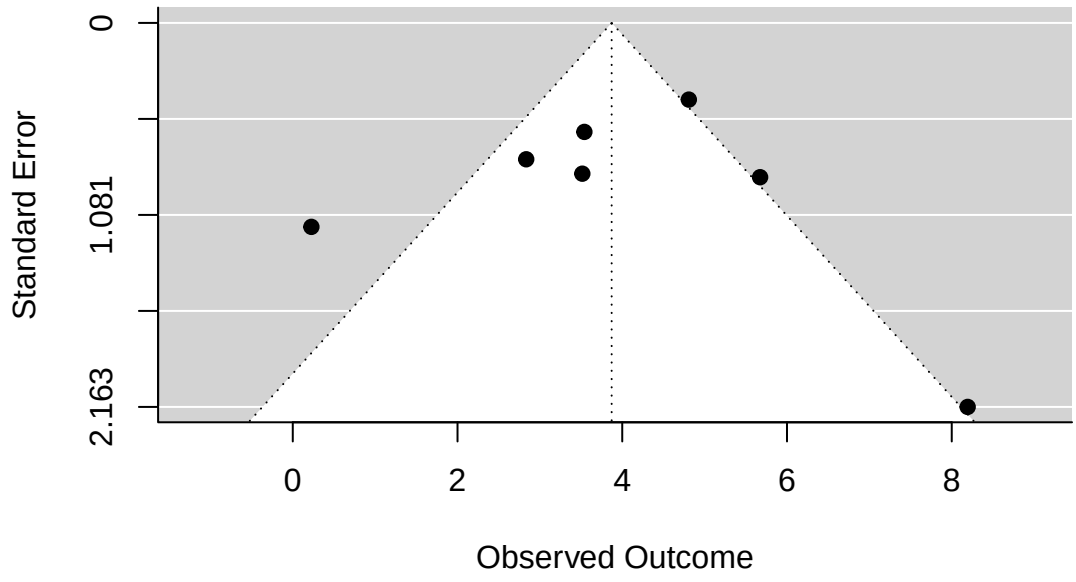
8.2 Method of Moments Funnel Plot

HPS = Hedges, Pustejovsky, & Shadish (2013)

```
data_bcsmd_un %>%
  metafor::rma(yi = delta_hat,
               vi = V_delta_hat,
               data = .,
               slab = study_id) %>%
  metafor::funnel()
```

Figure D.13

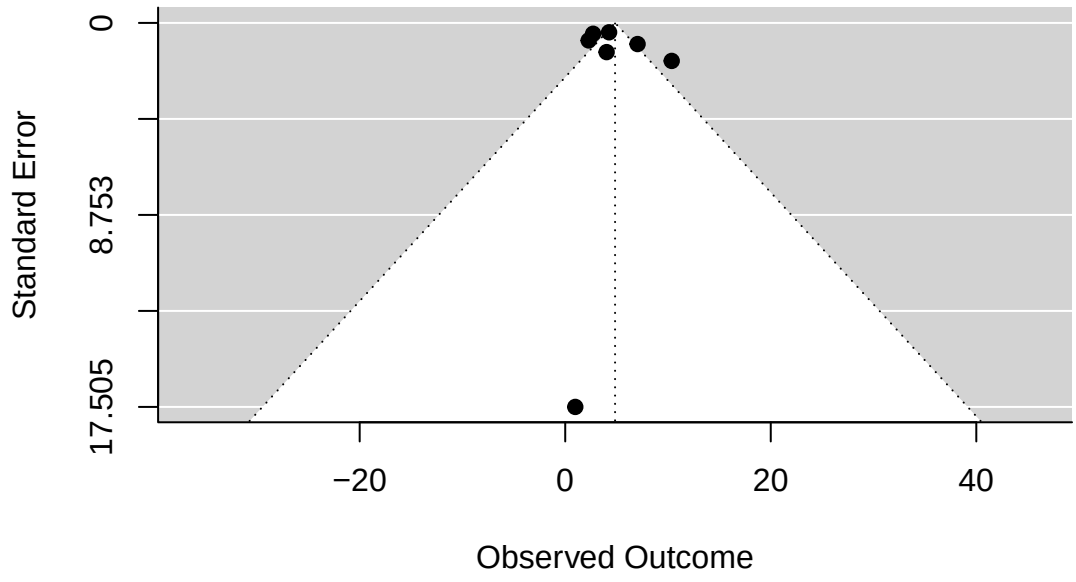
Publication Bias Funnel Plot Method of Moments



8.3 REML Adjusted Funnel Plot

```
data_bcsmd %>%
  dplyr::mutate(V_g_AB = (SE_g_AB)^2) %>%
  metafor::rma(yi = g_AB,
               vi = V_g_AB,
               data = .,
               slab = study_id) %>%
  metafor::funnel()
```

Figure D.14
Publication Bias Funnel Plot REML Adjusted



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