

Using Brief Experimental Analysis to Identify Effective Reading Comprehension Interventions for High School Students

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Abstract

This study examined the utility of Brief Experimental Analysis (BEA) as an efficient, data-driven method for identifying effective reading comprehension strategies for high school students with significant reading difficulties. Three ninth-grade students at risk of failing a social studies course participated in a multielement single-case design comparing three reciprocal teaching strategies (i.e., generating questions, summarizing, predicting) against a control condition. Reading passages and comprehension assessments were drawn directly from course textbooks to enhance ecological validity. Results indicated that BEA successfully differentiated effective strategies across participants. Summarizing and generating questions consistently produced the highest comprehension outcomes for two students, while all three strategies improved performance for the third student, with predicting yielding the strongest effect. Across participants, strategy-based conditions generally outperformed the control condition. Transfer effects, measured using MAZE assessments, showed meaningful gains in reading comprehension, with two students demonstrating strong improvement and one showing moderate progress. Growth rates exceeded typical norms, suggesting educationally significant change within a relatively brief intervention period. Overall, findings support BEA as a practical tool for rapidly identifying individualized reading comprehension interventions at the high school level. Despite limitations related to small sample size and limited exposure to conditions, the study contributes evidence that structured, strategy-based interventions embedded in authentic academic materials can meaningfully improve comprehension for struggling adolescent readers.

Keywords: brief experimental analysis, reading comprehension, intervention, high school students

1. Introduction

1.1 Study Background

Educators, parents, and policymakers have advocated for intensive and evidence-informed early literacy intervention to prevent below average readers from falling behind academically (Sheldon-Dean et al., 2023). Yet 70% of public-school 4th grade students and 67% of public-school 8th grade students in the United States fail to meet reading proficiency standards (U.S. Department of Education, 2024). Not surprisingly, students who struggle with reading in elementary and middle school often continue to face reading challenges at the high school level. In 2022, 65% of high school students scored below the proficient level (U.S. Department of Education, 2024). Beyond poor educational outcomes (e.g., dropout; Hernandez, 2011), high school students with below average reading skills are at heightened risk for psychological, behavioral, health, and long-term occupational difficulties (see Main et al., 2023).

Reading difficulties encountered by high school students frequently stem from inadequate reading comprehension or the inability to effectively process and comprehend information from text (Altwies, 2022). Fortunately, research on reading comprehension interventions for students is promising. Two meta-analyses reported medium to large effects for specific interventions (e.g., metacognitive interventions emphasizing prediction, summarization, and inferencing), although smaller effects were noted for multicomponent interventions or interventions that focused on decoding, fluency, vocabulary, text structure, and developing students' background knowledge (Scammacca et al., 2015; Sohn et al., 2023). Both meta-analyses also found that reading comprehension interventions delivered by researchers produced greater improvements than those implemented by teachers.

Reading interventions are most effective when individualized and based on student assessment data (Burns & Welland, 2024). In their review of the literature, Connor and Morrison (2016) provided correlational and experimental evidence supporting individualizing instruction to address student reading needs. For example, students with poor reading comprehension skills make greater improvements when instruction focuses on summarizing, questioning, and predicting. However, individualizing instruction and intervention at the high school level is complicated and not widely considered. Specifically, teachers report finding it difficult to individualize instruction (Van Casteren et al., 2017) and rarely adapt their instruction to individual student characteristics (Schleicher, 2016). Despite the rationale for individualizing interventions within a multi-tiered system of support (MTSS), where students frequently receive reading interventions in one-on-one or small-group settings, teachers continue to encounter challenges in providing adequate support to students (Connor & Morrison, 2016).

1.2 Brief Experimental Analysis

MTSS best practice models call for intervention implementation followed by assessing outcomes and using data to determine effectiveness (Burns et al., 2026). However, this problem-solving process can be time consuming and a notable barrier to engaging in practices that support students (Vaccarello et al., 2023). Identifying effective strategies

remains paramount to supporting high school students in reading comprehension, and finding a methodology to do so efficiently seems essential. Brief Experimental Analysis (BEA) provides educators with a means to quickly identify effective interventions before devoting substantial resources to implementation. BEA involves brief exposure to multiple instructional conditions, systematic withdrawal and reintroduction, and comparison of immediate student outcomes (Axelrod, 2017). BEAs use a single-case experimental design (SCED), allowing a student's educational team to compare immediate effects across strategies and select the most effective approach through empirical means (Daly et al., 1997).

The literature is replete with evidence supporting BEA's utility for identifying effective oral reading fluency interventions (see Burns & Wagner, 2008; Coolong-Chaffin & McComas, 2016). In fact, initial applications of BEA as a decision tool involved testing different instructional approaches alone and in combination (e.g., repeated reading plus listening passage preview) to determine students' responses on measures of oral reading fluency (Daly et al., 1999). However, few studies have investigated BEA's utility in selecting effective reading comprehension strategies. McComas et al. (1996) used BEA to compare the differential effects of two instructional approaches, a study guide and paraphrasing, on the reading comprehension of two high school students with specific learning disabilities in reading. Ritter (2020) investigated BEA of reading comprehension with three secondary school students with poor reading comprehension skills. The researcher tested four approaches (i.e., repeated reading, vocabulary preview, a self-monitoring strategy, question generation) to identify a tailored intervention. Graves and Burns (2024) used BEA to compare the effects of three reading comprehension strategies, reinforcement for accurate responding, story mapping, and researcher-generated comprehension prompts (e.g., "Pay attention to..."), with a middle school student performing below grade level in reading. The three studies yielded mixed results, suggesting the potential of BEA to empirically select effective reading comprehension interventions. Other studies on BEA of reading comprehension have investigated the effects of reading fluency interventions on reading comprehension but not reading comprehension interventions themselves (e.g., Cates et al., 2007; Nikanowicz, 2009).

In addition to the mixed findings, several notable limitations exist in the literature that preclude researchers from recommending educators consider BEA as a decision tool for selecting reading comprehension interventions. First and most obvious, the total number of subjects across these published studies is very small. Therefore, it remains largely unknown whether BEA can be used to facilitate reading comprehension intervention selection, especially for high school students.

Second, although Daly et al. (1997) initially suggested BEAs be built from hypotheses that might explain the reading skill deficit, there is no evidence for a specific framework for selecting reading comprehension strategies to test within the BEA. Ritter (2020) considered strategies that addressed four skill areas often cited as reasons why a student might struggle with reading comprehension (i.e., vocabulary, reading fluency, self-monitoring, and connecting prior knowledge), and Graves and Burns (2024) used reading comprehension strategies that drew on the hypotheses that a student might not be motivated, might need additional support, or has not been prompted to read for comprehension. However, there are

other systems for conceptualizing reading comprehension instructional strategies. For example, many students benefit from explicit instruction in strategies that occur before, during, and after reading a story or passage (Duke et al., 2021).

Finally, studies varied on their method for obtaining reading passages and comprehension questions. For example, Graves and Burns (2024) used leveled reading passages and corresponding multiple-choice comprehension questions available online, Cates et al. (2007) took reading probes from a state department of education website and developed their own set of written comprehension questions, and Ritter (2020) had participants read from a set of commercially available leveled passages and complete corresponding comprehension questions. Only McComas et al. (1996) generated passages and corresponding comprehension questions from reading material taken from participants' general education school curriculum.

1.3 Study Objectives

This study addressed key limitations in the BEA literature for reading comprehension at the high school level. Specifically, the study sought to contribute to the limited but expanding body of research on employing BEA as a decision-making tool for selecting reading comprehension interventions or strategies for struggling readers. The study's participants were high school students who were at risk of failing a 9th-grade social studies class. The study identified reading comprehension strategies evaluated using BEA that were derived from reciprocal teaching activities described by Palincsar and Brown (1984) in their study investigating reading comprehension approaches for middle school students. Strategies were embedded throughout the passages to maximize practice opportunities and feedback. Reading passages for the BEA and comprehension questions were directly sourced from students' classroom textbook. This was done to enhance the intervention's ecological validity, or the extent to which the intervention's effects might generalize beyond the study.

2. Method

2.1 Setting

A large Midwestern suburban high school served as the study's location. A university-sponsored academic intervention program collaborated with the high school to provide evidence-informed reading interventions, delivered by undergraduate tutors, to at-risk students identified by teachers and staff. All sessions were conducted in small workrooms with a table and chairs. Each participant–interventionist dyad was assigned to a single room. The study was conducted across six weeks between the end of October and mid-December.

2.2 Participants

Three 9th-grade students, Betty, Fiona, and David (all pseudonyms), participated in the study. All three were referred for reading support by their social studies teachers because of failing grades. School staff confirmed that all participants were at risk for failing 9th-grade American History. Teachers and school staff hypothesized that each participant's failing grade was a result of multiple factors, especially poor reading comprehension skills. Progress monitoring data collected before the intervention began confirmed these reports. Middle-of-year reading

comprehension assessment percentile ranks for Betty, Fiona, and David were 2%, 1%, and 4%, respectively. All three participants spoke English as their primary language. None of the participants were receiving special education services at the time of the study, and there were no concurrent reading interventions while the study took place.

2.3 Reading Passages

In consultation with the social studies teachers, the first author copied 200-300-word passages from the participants' American History textbook. The selected passages were taken from current content. That is, the participants were expected to be reading those passages as part of the class's expectations. The selected passages spanned a Lexile range (i.e., the numbered measurement used to match readers' skill with text difficulty) of 950 to 1100 which corresponds to grade-level equivalents between 8th to 10th. These passages served as the reading passages for all intervention sessions.

2.4 Dependent Variables

The primary outcome variable used for the study was reading comprehension. Comprehension checks were administered following participants' reading of each passage and consisted of 10 or 11 multiple-choice questions, including seven factual items and three or four inferential items related to the specific passage. Factual items assessed information stated explicitly in the text, while inferential items required participants to integrate information and draw conclusions beyond what was directly stated. Each passage included a mix of factual and inferential items to ensure balanced measurement of comprehension skills rather than variation in passage difficulty. The questions were developed by the first author and reviewed for content validity by the second author (see Day & Park, 2005). Item difficulty was considered during development by aligning comprehension across factual and inferential items, ensuring that individual passages and assessments were comparable in overall difficulty. The comprehension checks measured participants' responses to the different reading comprehension strategies. Raw scores were converted to a percent correct by dividing the number of questions answered correctly by 10 or 11 and multiplying by 100.

Researcher-developed comprehension checks were selected because they allowed the assessment content to be directly aligned with the instructional passages used in the intervention and reflected the types of reading tasks participants encountered in their social studies coursework. This approach enhanced ecological validity by evaluating comprehension of authentic classroom materials rather than decontextualized reading passages. To support content validity, items were developed to measure both factual and inferential comprehension and were reviewed by the second author for alignment with passage content and intended comprehension outcomes. In addition, all passages included a similar proportion of factual and inferential items, and item development procedures were designed to promote comparable difficulty across assessments. Although formal psychometric analyses were beyond the scope of this study, these procedures were implemented to increase the validity and consistency of the comprehension measures.

To measure transfer of reading comprehension skills, researchers administered MAZE

reading comprehension passages to participants before, during, and after the intervention. Participants silently read passages where every seventh word was replaced by parentheses containing three options (the correct word and two distractors) and selected the word making the most sense. This assessed their ability to construct meaning, use context, and monitor understanding while reading text. MAZE passages were taken directly from the participants' American History textbook, similar to how the reading passages were developed. Researchers calculated the number of correct responses after three minutes to obtain a raw score and used Acadience Reading Percentile Ranks for Maze, 8th Grade Middle of Year (Acadience Learning, 2025) to convert raw scores to percentiles. Using 8th-grade scoring norms for 9th and 10th grade is an acceptable practice for progress monitoring to identify struggling readers (Milone, 2008).

2.5 Tutor Characteristics and Study Protocol Training

Graduate and undergraduate student tutors affiliated with the academic intervention program delivered all reading comprehension strategies and administered reading comprehension checks and MAZE passages. University students were assigned to one participant and served as that participant's tutor throughout the study. The tutors were trained by the first author to implement the study protocol. The training involved didactic instruction, modeling, multiple opportunities for practice, and immediate feedback. The first author assessed tutors' implementation fidelity through practice sessions. Tutors were deemed ready to implement study procedures after they achieved 100% fidelity during practice sessions.

The first author also provided ongoing support and feedback throughout the study. Before each session, tutors were reminded of the day's procedures. Debriefing between the first author and tutors occurred following each session and included providing feedback about procedural fidelity, reviewing data on participant progress, and problem-solving issues that might have occurred during the session. The debriefings typically lasted less than five minutes.

2.6 Procedures

The authors obtained approval from their university's Institutional Review Board for the Protection of Human Subjects prior to participant recruitment. The first author next consulted with social studies teachers and school staff to obtain possible referrals. Parents of referred students were provided an informed consent letter introducing the study, highlighting its purpose and procedures, describing potential benefits and risks, and detailing confidentiality and privacy issues. Researchers and school staff then obtained parental consent for those students participating in the study. Participants met with the first author and the tutor to discuss the referral, the study's procedures, and potential benefits and risks. The first author obtained assent from all participants.

2.6.1 Control Condition

During the control condition, participants read passages aloud without feedback from the tutors, then completed the comprehension-check questions. Tutors provided behavior-specific praise for effort and engagement in the tasks. No strategies were implemented during the control condition sessions.

2.6.2 Reading Comprehension Strategy Conditions

The three strategies were derived from Palincsar and Brown's (1984) study examining reciprocal teaching approaches to improve reading comprehension of older students. Reciprocal teaching involves an interventionist or teacher directing the student to read passage content in more meaningful ways. This approach employs behavioral skills training, which uses modeling ("I do"), guided practice ("we do"), and individual application ("you do;" see Axelrod, 2017). The strategies described by Palincsar and Brown (1984) and used in the current study were generating questions, summarizing, and predicting. Table 1 highlights notable aspects of the three strategies. Appendix A provides the protocol for each intervention condition.

Table 1. Reciprocal Teaching Strategies Summary

Strategy	What It Is	What Students Do	How It Supports Comprehension
Generating Questions	Students create questions about the text	Ask main-idea questions; use own words	Supports active reading and comprehension monitoring
Summarizing	Restating key ideas from the text	Identify main ideas	Checks understanding and improves retention
Predicting	Anticipating upcoming content	Use cues to guess what comes next	Activates prior knowledge; promotes inference-making

Participants completed the comprehension-check questions following the individual application of the strategy to the reading passages. Tutors provided behavior-specific praise for effort and engagement in the tasks.

2.6.3 MAZE Passages

Tutors administered MAZE passages to participants using standard directions outlined by Shinn and Shinn (2002) in the AIMSweb Training Workbook. Participants were first given a MAZE passage. They were then told to read the story silently, circle the one word that made the most sense when presented a group of three words in parentheses, and continue reading until they heard "stop!" or had finished the passage. A practice MAZE passage was given to participants during the session when MAZE passages were first introduced. Unlike the comprehension-check questions, the MAZE passages were not used for the intervention but, rather, to assess skill transfer.

2.6.4 Session Format

Sessions were approximately 30 minutes, twice per week, and generally followed a similar format throughout the study. Sessions typically began with a brief conversation between the tutor and participant about school and popular culture (e.g., music). The tutor then reviewed the session's condition (i.e., control, generating questions, summarizing, predicting), including its procedures. Finally, the intervention was implemented (or was skipped during

control condition sessions), followed by the participant answering the comprehension check questions.

2.7 Experimental Design and Data Analysis Strategies

A brief multielement (rapidly changing reversal) design was used with all participants to identify the most effective reading comprehension strategy. Table 2 provides the order of conditions across the BEA. The initial study protocol intended for each participant to complete each condition three times for a total of 12 sessions. Sessions were scheduled twice per week across 6 weeks, depending on participant availability. Effects of the control condition and three strategies were determined by visually reviewing graphical representations of the data and conducting descriptive analyses of each condition's mean.

Table 2. Order of Conditions.

Session	1	2	3	4	5	6	7	8	9	10	11	12
Condition	Con	GQ	Sum	Pre	Con	Con	GQ	Sum	Pre	GQ	Sum	Pre

Note. Con = Control; GQ = Generating Questions; Sum = Summarizing; Pre = Predicting

An ABA design was used to measure transfer of reading comprehension skills across the BEA. Three baseline MAZE passages were administered prior to implementation, followed by two passages during the BEA and one passage after completion. Effects of the reading comprehension strategies on MAZE performance were evaluated using visual inspection, descriptive analysis, Percentage of Non-overlapping Data (PND), and rate of improvement (ROI). PND, an effect size commonly used in single-case research, represents the percentage of intervention data points that exceed the highest baseline point (Vannest et al., 2013). Interpretive guidelines suggest the following: values between 90% and 100% indicate the intervention was very effective, values between 70% and 89% indicate the intervention was effective, values between 50% and 69% indicate questionable intervention effects, and values less than 50% indicate the intervention was ineffective (Scruggs & Mastropieri, 1998). Rates of improvement were calculated by subtracting the number of correctly identified words at session 1 from the number at session 8 and dividing by six weeks.

2.8 Procedural Fidelity and Interscorer Agreement

To assess procedural fidelity, protocol checklists were created for the control condition and all three BEA strategies (see Appendix A). A research assistant trained in the study protocol listened to audio recordings of 33% of all sessions across all study phases and recorded procedural fidelity using the checklists. Procedural fidelity was calculated by dividing the number of procedural steps followed correctly by the total number of procedural steps and multiplying by 100 to obtain a percentage of steps followed correctly. Procedural fidelity was 100%, indicating the control and intervention conditions were implemented as designed.

Interscorer agreement was calculated for 100% of all reading comprehension checks and MAZE passages. The same research assistant listened to audio recordings of both outcome measures and recorded the percent of reading comprehension questions answered correctly and the total number of correct MAZE responses in three minutes. The first author then

calculated the percentage of agreement between their data and the data collected by the tutors by dividing the number of agreements by the total number of agreements and disagreements and multiplying by 100. The interscorer agreement was 100% for both the reading comprehension checks and MAZE passages, indicating the data were accurate.

3. Results

3.1 Brief Experimental Analysis

Figure 1 provides a graphic display of each participant's percent correct for reading comprehension checks across the study's four conditions (i.e., control, summarizing, generating questions, predicting). Table 3 indicates the mean percent correct for each subject across the four conditions.

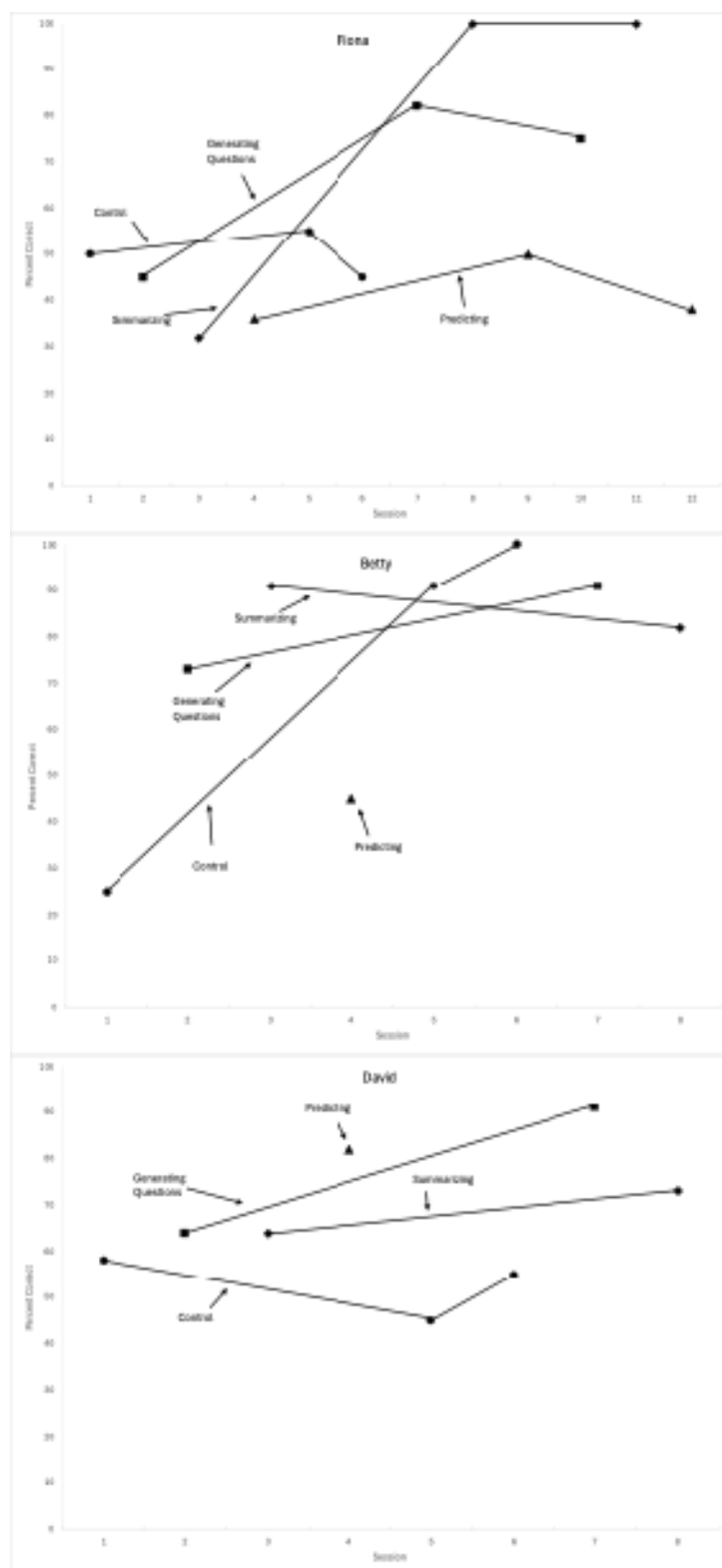


Figure 1. Percent Correct across all Brief Experimental Analysis Conditions for Each Participant

Table 3. Mean Percent Correct for Each Participant Across All Four BEA Conditions

	Control Condition	Generating Questions	Summarizing	Predicting
Fiona	50%	67%	77%	41%
Betty	72%	82%	87%	45%
David	53%	78%	69%	82%

The BEA was able to identify two strategies, summarizing and generating questions, that were effective at improving Fiona's and Betty's reading comprehension when compared to the control condition. For both Fiona and Betty, the predicting strategy was not effective when compared to the other two strategies or the control condition. The BEA identified the three strategies as effective at improving David's reading comprehension when compared to the control condition.

For Fiona, summarizing produced the highest mean comprehension score (77%). This was followed by the generating questions strategy (67%). In addition, Fiona's reading comprehension performance under the predicting strategy was lower compared to the control condition. Within the two most effective strategies, some variability in Fiona's performance was observed. Her initial scores for both the summarizing and generating questions strategies were lower than the control condition mean of 50%. However, subsequent exposures to each strategy led to a marked improvement in Fiona's performance. Most notably, she achieved 100% correct following the second and third summarizing strategies.

For Betty, summarizing and generating questions produced the high mean comprehension scores (87% and 82%), respectively. However, she was unable to attend the third session for each condition due to absences. Like Fiona, Betty's reading comprehension performance under the predicting strategy was lower than that of the control condition, although she experienced the predicting strategy only once due to absences. Betty's percentage of correct responses improved significantly from the first control session (25%) to the second (91%) and third (100%) control sessions. Her performance also increased from the first generating questions session (73%) to the second (91%).

David's mean reading comprehension scores improved most following the predicting (82%) and generating questions (78%) strategies, although he completed the predicting intervention only once and the generating questions strategy twice because of absences. His mean performance was lower after the summarizing strategy (69%) and lowest in the control condition (53%). David improved his reading comprehension performance across both sessions of the generating questions and summarizing strategies.

Fiona demonstrated the greatest variability in the summarizing condition, where performance increased from approximately 32% to 100% (range = 68 percentage points). The generating questions condition also showed substantial variability, ranging from about 45% to 82% (range = 37 points). In contrast, the control condition was relatively stable (45%-55%; range = 10 points), and the predicting condition showed modest variability (36%-50%; range = 14 points).

Betty exhibited considerable variability in the control condition, with scores increasing from

approximately 25% to 100% (range = 75 points). Variability was much lower in the intervention conditions. Scores in summarizing ranged from 82% to 91% (range = 9 points) and generating questions ranged from 73% to 91% (range = 18 points). Only one data point was available for predicting, precluding assessment of variability.

David showed relatively low variability across conditions. The control condition ranged from approximately 45% to 58% (range = 13 points), generating questions ranged from 64% to 91% (range = 27 points), and summarizing ranged from 64% to 73% (range = 9 points). Only one data point was available for predicting (82%), preventing evaluation of variability.

Overall, the largest ranges were observed for Fiona's summarizing condition and Betty's control condition, suggesting substantial performance changes across repeated exposures. In contrast, most intervention conditions for Betty and David demonstrated relatively stable responding, with ranges below 20 percentage points. This pattern suggests that variability was generally greater during conditions where participants exhibited marked improvement over time than during conditions characterized by consistently high or low performance.

3.2 MAZE Passages

MAZE passages were administered to all three participants to assess reading comprehension skills transfer by evaluating the effects of the collective strategies. Figure 2 displays each participant's correctly identified words across the study's three phases (i.e., pre-BEA, during-BEA, post-BEA). Stable baselines (i.e., pre-BEA) were observed for Fiona and David. Betty's baseline showed a slight decrease followed by a sharp increase in correctly identified words. Noteworthy increases from pre-BEA to during-BEA were observed for Fiona and Betty. David demonstrated a slight increase from pre-BEA to during-BEA phases. Participants maintained or increased their correctly identified words from during-BEA to post-BEA phases.

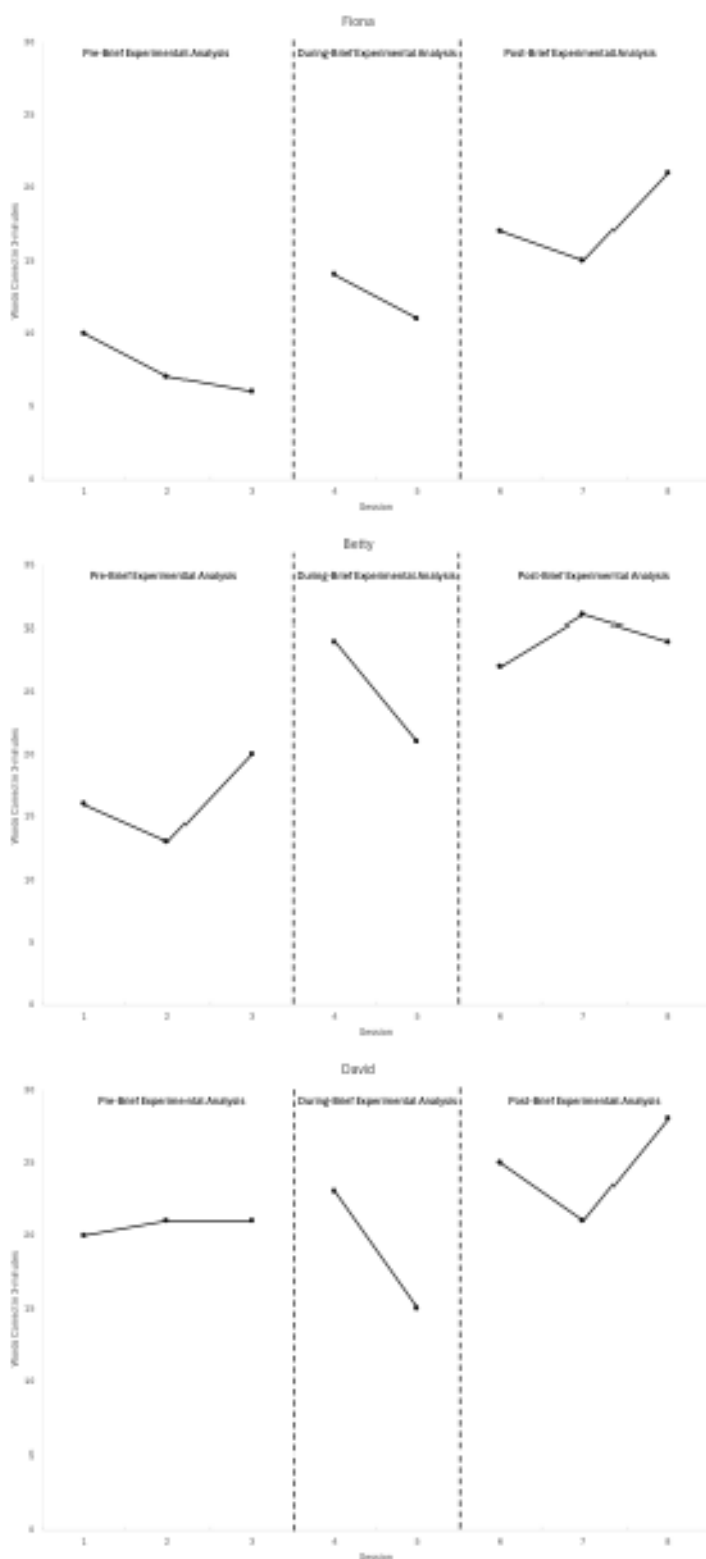


Figure 2. Each Participant's Words Correct in 3-minutes on MAZE Passages across all Phases of the Study

Fiona's mean correctly identified words during the pre-BEA phase was eight, placing her in the 1st percentile when compared to same-age peers. Her mean correctly identified words during the post-BEA phase was 18, placing her in the 3rd percentile when compared to same-age peers. Betty obtained a mean of 16 (2nd percentile) during the pre-BEA phase and 29 during the post-BEA phase (6th percentile). Finally, David's mean during the pre-BEA phase was 21 (4th percentile) and 25 during the post-BEA phase (6th percentile). PND values for Fiona and Betty were 100%, indicating the collective strategies were very effective. The PND value for David was 67%, indicating the collective strategies were of questionable effectiveness. Rates of improvement in correctly identified words per week were 1.8, 2.2, and 1.3 for Fiona, Betty, and David, respectively. All were well above typical MAZE growth rates of approximately 0.4 correctly identified words per week (see Tolar et al., 2012).

4. Discussion

4.1 Main Findings

This study demonstrated that BEA has the potential to efficiently differentiate effective reading comprehension strategies for high school students with reading difficulties. Two participants exhibited improvements in reading comprehension performance when summarizing and generating questions strategies were implemented. For one participant, improvements were observed when summarizing, generating questions, and predicting strategies were implemented. Although research on using BEA as a decision-making tool to identify reading comprehension strategies shows promise, the total number of subjects across the few published studies remains small. The study's findings add to this growing body of literature on BEA as a useful decision-making tool for selecting reading comprehension strategies for high school students.

In addition, two of the three participants made noteworthy improvements in their reading comprehension during the study. That is, the reading comprehension skills developed during the study's six weeks transferred to progress monitoring MAZE passages following implementation of the three strategies and control condition. For the third participant, the three strategies and control condition demonstrated questionable effectiveness when assessing reading comprehension using MAZE passages. Although MAZE passages do not provide a standardized criterion for determining clinical significance, the observed growth rates for all three participants were notably higher than expected normative progress. Gains in correctly identified words per week (1.8, 2.2, and 1.3) substantially exceeded typical growth rates of approximately 0.4 correctly identified words per week (Tolar et al., 2012). Given the relatively brief duration of the study (8-12 total sessions, including 5-9 active intervention sessions over six weeks), these improvements represent educationally meaningful progress in reading comprehension. Collectively, these findings offer further support for the use of the BEA's three strategies (i.e., summarizing, generating questions, and predicting) as effective approaches for improving high school students' reading comprehension.

The study's findings are important for two additional reasons. First, the strategies employed within the BEA came from reciprocal teaching activities described by Palincsar and Brown (1984) in their study examining reading comprehension approaches for older students. Other

studies using BEA to identify reading comprehension strategies emphasized specific skills deficits (e.g., vocabulary, reading fluency), comprehension-monitoring activities (e.g., self-monitoring, connecting prior knowledge), or motivational factors (see Graves & Burns, 2024; Ritter, 2020). However, the current study used specific strategies designed to promote comprehension by building, maintaining, and deepening students' understanding of the text. The strategies used (i.e., summarizing, generating questions, and predicting) characterize proficient readers and highlight how teachers might foster reading comprehension for all students (Buehl, 2013).

Second, this study utilized reading passages and comprehension questions sourced from students' classroom textbooks. In contrast, previous studies obtained reading passages and corresponding comprehension questions from online sources (e.g., state department of education; Cates et al., 2007; Graves & Burns, 2024) or commercially available material (Ritter, 2020). Notably, only McComas et al. (1996) employed passages and corresponding comprehension questions derived from reading material incorporated into students' curricula. Relying on content taken from students' textbooks enhances ecological validity and addresses the gap between research contexts and real-life circumstances frequently noted in reading intervention research (Reed et al., 2013).

4.2 Limitations and Directions for Future Research

Although this study contributes to the emerging literature on BEA for reading comprehension strategies, limitations should be noted. First, the study included only three participants from a single suburban high school, which limits the generalizability of findings to more diverse student populations. Additional research is needed to replicate these results and further establish BEA as a decision-making tool for selecting reading comprehension strategies at the high school level.

Second, the study failed to use an extended analysis to evaluate the overall stability and effectiveness of the selected strategy. This limits the study's conclusions that the strategies identified as effective could be used to improve subjects' reading comprehension skills. Future research should employ an extended analysis using an ABAB design that confirms and replicates observed changes in students' reading comprehension performance and thus establish a causal relationship between the selected strategy and the outcome measure.

Third, participant absences reduced the planned number of strategy exposures for some conditions. Reduced exposure limits confidence in determining the relative effectiveness of certain strategies and introduces variability not attributable to the intervention itself. Although applied research often cannot control for these absences, future research might account for missing data points by extending the BEA across additional sessions to ensure participants are equally exposed to all conditions.

Fourth, although BEA is designed to isolate the short-term effects of instructional conditions, the study relied on passages from a single subject-area textbook, which likely constrained the breadth of text types and difficulty levels. Using content exclusively tied to students' social studies coursework enhanced the study's ecological validity but also restricted the ability to

infer whether identified strategies would generalize to other genres or academic domains. Future research might consider using passages from other subject matter (e.g., science, literature). Related, taking passages directly from students' subject-area textbooks, while enhancing the study's ecological validity, limited researcher control over difficulty level. Although Lexile ranges for the selected passages were similar and within participants' grade level (i.e., between 8th and 10th grade), this method may impact the study's internal validity.

Fifth, rapid alternation of conditions, while appropriate for BEA, raises the possibility of carryover effects particularly given that reciprocal teaching strategies may influence how students approach subsequent readings. For example, Betty demonstrated noteworthy improvements across control sessions. Furthermore, these effects may be responsible for participant performance across BEA conditions. Fiona made impressive gains from the first to the second summarizing session. The multielement design used in BEAs complicates data interpretation, raising questions about potential learning and practice effects. Additional research is needed to understand how to best understand data trends when multielement designs are used for BEAs.

Finally, the primary outcome measure consisted of researcher-developed comprehension checks. Although steps were taken to enhance content validity and comparability across assessments, future research should examine the reliability and validity of these measures more formally and consider including standardized comprehension assessments as additional outcome measures. In addition, transfer of comprehension skills was measured using MAZE passages, a widely used but somewhat crude indicator of comprehension. Complementing MAZE scores with additional measures (e.g., written retellings, oral summarization, or curriculum-based comprehension probes) would strengthen inferences regarding broader and more durable skill acquisition.

4.3 Conclusion

Despite the limitations, the current study offers promising results. The findings suggest that BEA may be a viable method for selecting reading comprehension strategies for high school students. High schools need efficient, data-driven methods to support struggling readers. BEA may provide educators with a tool that empirically selects strategies that characterize skilled readers.

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Author contributions

Mr. Smith and Dr. Axelrod were responsible for study design, study implementation, and data analysis. Mr. Smith was responsible for data collection. Dr. Axelrod drafted the manuscript,

and Mr. Smith assisted in revisions. All authors read and approved the final manuscript.

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Informed consent

Obtained.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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Appendix A

Intervention Protocols

Generating Questions

1. Place a copy of the intervention passage in front of the student. Say, "This strategy will help you ask and answer questions so that you can better understand the story. When you're reading, you want to ask questions about the text so that you can be sure you understand what's happening in the story."
2. *Modeling (I Do)*: Read the first two paragraphs aloud. Say, "I wonder why/what/who, etc. is X, so I'm going to write that question down. I know I want to ask questions that are about the main idea of the story because that's the most important information." Write your question down.
3. *Guided Application (We Do)*: Have the student read a paragraph or two aloud and think of the questions together. Ask student to repeat what you did with a different question - start the process and have the student follow. Give feedback and direction.
4. *Individual Application (You Do)*: Student practices on their own with guidance if necessary for the remaining paragraphs. Have the student read an additional paragraph or two and write down a question. When the student finishes have them share their question and why they wrote that question. Emphasize that questions should focus on important information in the story.

Summarizing

1. Place a copy of the intervention passage in front of the student. Say, "We're going to learn about summarizing. When you summarize something you've read, you think about what's most important. When you read a paragraph, there are one or two ideas that are most important that you want to remember. You don't need to memorize the whole paragraph. Summarizing helps you think about the most important information when you're reading so you don't have to try to remember every little thing you've read."
2. *Modeling (I Do)*: Read one or two paragraphs aloud. Say, "Those paragraphs were about

- X. The most important information from those paragraphs was X, so that's what I'm going to write for my summary." Write one or two sentences that sum it up. Read summary aloud and say, "I chose these sentences for my summary because that was the most important information in those paragraphs."
3. *Guided Application (We Do)*: Ask student to repeat what you did with a different summary- start the process and have the student follow. Have the student read one or two more paragraphs aloud and summarize those paragraphs aloud. Provide guidance as necessary.
 1. Two common errors
 - a. Providing too much detail
 - b. Only referencing a section of the passage
 2. Provide feedback with questions.
 - a. Does your summary cover the whole story or just part of it?
 - b. If I asked you to tell me what the story was about using only 2 sentences, what would you say?
 4. *Individual Application (You Do)*: Student practices an additional paragraph or two on their own with guidance if necessary. Have student explain summary when finished.

Prediction

1. Place a copy of the intervention passage in front of the student. Say, "This strategy will help you connect to the passage/story. It will give you a purpose for reading because you will be anticipating the ending or highlights in the passage/story."
2. Before the interventionist begins reading the passage, look at the main title, scan the pages to read the major headings, and look at any illustrations.
3. *Modeling (I Do)*: Say, "The title of this story is X. That title makes me think the story might be about X. I can use the title of the story to help me think about what the story is going to be about, and then I can try to figure out if I'm right when I'm reading." (repeat with headings and/or illustrations).
4. *Guided Application (We Do)*: Ask the student to repeat what you did with a different prediction - start the process and have the student follow. Give feedback and direction. Say, "Now you are going to make a prediction, based off of the title, what do you think is going to happen in this story?"
 - a. Begin reading the first paragraph aloud. Model one additional prediction based on the first paragraph. Say, "I think X is going to happen because of X."
 - b. Have the student read one paragraph and make one prediction aloud. Say, "Read the first paragraph and tell me what you think is going to happen in the story."
5. *Individual Application (You Do)*: Student practices exercise for each remaining paragraph. Have the student say the prediction and why they made that prediction.