

Bridging (and Elaborating on) the Achievement Gap

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Abstract

Researchers have long been interested in understanding and closing the “reading gap” that exists between White and racially marginalized students. This study explored whether group differences in inference strategies (i.e., bridging and elaboration) and comprehension performance existed among college readers. Three hundred college participants who self-identified as White, Black, or Hispanic completed a think-aloud task along with measures of reading proficiency and comprehension. Results from hierarchical regression models indicated that group differences in elaborative strategies were present, but differences in bridging strategies and comprehension performance disappeared when foundational skills in reading were included in the models. The results are explained in terms of inequities in educational experiences prior to entering college.

Keywords: bridging; elaboration; reading comprehension; achievement gap; equity

Introduction

It is well established that an “achievement gap” exists between White students and students of color (e.g., Jencks & Phillips, 1998). This gap is evident in a variety of domains, but of concern in the present study is a gap that persists in reading comprehension, which has increased in recent years (e.g., Bush & Bush, 2010; Kugelmass & Ready, 2011; NAEP, 2019). The achievement gap has implications for college success. While many students come to college unprepared to meet the literacy demands of their course work (Bailey, Jeong, & Cho, 2010; NAEP, 2019), this issue is more pronounced for college students of color (e.g., Kugelmass & Ready, 2011; Major, 2019; Welton & Martinez, 2014).

As to be expected, there are considerable efforts to address this gap from educational policy makers (e.g., Bower, 2013; Gillborn et al., 2017). However, the cognitive sciences can play a role in understanding the gap because theory and research delineates the cognitive mechanisms that support academic success across a variety of activities, such as reading, math, and disciplinary specific learning (e.g., history and science). In the present study, the focus was on reading comprehension and the learned inference strategies that support it.

Research demonstrating the gap in reading involves the administration of high-stakes standardized tests of comprehension (e.g., NAEP, 2019). These tests are not designed to provide insights into the cognitive processes and strategies that support comprehension (Magliano & Millis, 2003), which involves building a mental model (e.g., Graesser, Singer, & Trabasso, 1994; Kintsch, 1988). We contend that exploring differences across participants from different racial backgrounds with respect to learned inference strategies that support mental model construction can yield insights into the achievement gap which have implications on how to address it.

Constructionist View of Comprehension

A universal feature of theories of comprehension that have been postulated in the cognitive sciences is that comprehension emerges through the construction of a coherent mental model (McNamara & Magliano, 2009). Coherence is achieved through a coordination of memory-based and effortful strategies (Long & Lea, 2005). However, effortful and deliberate strategies are likely more important for establishing coherence for expository texts than narratives (McNamara, 2004). The present study was concerned with the propensity of students to engage in the conscious and deliberate strategies that support coherence when reading expository text.

The constructionist theory of comprehension posits that comprehension requires active meaning-making strategies (Graesser et al., 1994). As readers engage with a text, they seek to obtain a coherent explanation of its content and construct a mental representation that is in line with their goals (Magliano, Trabasso, & Graesser, 1999). Key to this theory is the concept of self-explanation—the act of explaining, either explicitly or tacitly, the meaning of a text to oneself (Chi et al., 1989; McNamara, 2004).

Self-explanation involves establishing how content one is reading connects to two sources of information: 1) information explicitly conveyed in the text or 2) information inferred through one’s prior knowledge (McNamara & Magliano, 2009). The process of connecting text content that one is currently reading to previous text content is known as *bridging*. Bridging is an important inference process that allows

one to establish causal coherence. One's ability to generate bridging inferences while reading has been used to differentiate skilled from less skilled readers and has been shown to be related to comprehension outcomes (e.g., Magliano & Millis, 2003).

Readers must also connect information from the text to existing knowledge. The process of establishing these types of connections with knowledge is known as *elaboration*. Elaboration is a knowledge-driven process that goes beyond the content found in a text to fill in gaps in coherence and promote deeper comprehension (McNamara & Magliano, 2009). Readers can draw upon knowledge in the form of schemas (i.e., well-formed representations of one's background experience) or in the form of domain knowledge that is more specific in nature (Graesser et al., 1994). Research suggests that bridging and elaboration are important to comprehension and account for variance in comprehension outcomes over and above proficiency in basic reading processes (e.g., word decoding, word recognition, vocabulary, etc.; e.g., Cromley & Azevedo, 2007; Feller et al., 2020).

Text-based and Knowledge-based Hypotheses

We have conducted a series of studies comparing college students enrolled in developmental literacy programs to those who are not with respect to strategies involved in self-explanation. Developmental literacy programs are postsecondary programs that are intended to help students who are institutionally designated as not ready for the literacy demand of college (typically based on performance on standardized tests). These studies utilized a think-aloud methodology to explore the use of a *bridging strategy* that connects explicit sentences in texts and *elaboration strategy* that involves using prior knowledge to establish coherence. These studies provided a basis for testing two hypotheses that speak to different shortcomings in the educational experiences of developmental students. A *text-based hypothesis* assumes that developmental students come to college with insufficient support in the basic bridging strategies that support comprehension. A *knowledge-based hypothesis* assumes that developmental students come to college with insufficient educational experiences needed to develop a knowledge base that supports elaboration.

Magliano et al. (2020) had a sample of developmental ($n = 23$) and non-developmental students ($n = 22$) from a four-year institution think aloud while reading expository texts. They found support for the knowledge-based hypothesis, but not the text-based hypothesis. Feller, Sabatini, and Magliano (2024) replicated this finding with a much larger sample of four-year college students ($n = 258$) and demonstrated evidence for the knowledge-based hypothesis while accounting for individual differences in the foundational skills of reading. They similarly did not find support for the text-based hypothesis. However, Feller et al. (2020) conducted a study involving a large sample of students from a community college and found differing results. This is significant because community colleges do not have

admissions criteria, whereas four-year institutions do. As such, the differences between developmental and non-developmental students may not be as significant as at a four-year institution. They did not find evidence for either hypothesis when accounting for proficiency in the foundational skills of reading. These studies underscore the need to test if these hypotheses are part of the basis of the achievement gap and testing them has implications on how to ameliorate the gap.

Overview of the Study

The goal of the present study was to test if the text-based and knowledge-based hypotheses explained differences in the propensity to engage in self-explanation strategies for students of different racial backgrounds. We used archival data from Feller et al. (2020; 2024). The sample had sufficient diversity to explore differences across participants who identified as White, Black, and Hispanic. These studies involved administering the Reading Strategy Assessment Tool (RSAT; Magliano et al., 2011), which provided computationally generated scores reflecting the propensity to bridge and elaborate when engaged in typed think-aloud tasks. A standardized assessment of the foundational skills of reading and reading comprehension was also administered, which afforded testing the hypotheses while accounting for the foundational skills of reading.

We postulated two hypotheses that are based on the assumption that marginalized students have different educational experiences that have implications on learned inference strategies. The text-based hypothesis assumes that students of color in the sample were underserved by the prior educational experiences in terms of helping them develop basic comprehension strategies. It predicts that there would be lower bridging scores for students of color relative to White students. The knowledge-based hypothesis assumes that that marginalized students of color are underserved in terms of building the prior knowledge needed to establish coherence when reading expository texts, and in particular with respect to disciplinary specific knowledge (e.g., history, biology, earth sciences, etc.). It predicts that there would be lower elaboration scores for students of color relative to White Students.

In addition to testing these hypotheses, we assessed if there were differences across racial groups in terms of comprehension, while controlling for the foundational skills of reading, bridging scores, and elaboration scores.

Method

Participants

A subset of 300 participants was selected from a large dataset for this study. All participants had completed at least one of two study sessions associated with a large grant. Participants were recruited from a large 4-year Midwestern university as well as a community college district in the South-Central United States. Of the participants, approximately 32% self-

identified as White, 53% as Black, and 15% as Hispanic. Participants from other racial backgrounds were excluded from this study due to small sample sizes. All participants reported English as their first language. Participants received monetary compensation, course credit, or gift certificates for participating in each session, depending on their location and choice. The majority of participants were first year students enrolled in developmental literacy courses designed to improve their reading and writing ability. See Table 1 for participant demographics.

Materials

Reading Strategies Assessment Tool (RSAT) RSAT (Magliano et al., 2011) is a tool designed to assess the extent to which readers engage in inference strategies while reading. It was developed for a college population. Participants read texts, presented one sentence at a time, on a computer screen. At target locations, participants were prompted to report their thoughts by typing a response into a text box. Specifically, participants were instructed to report whatever thoughts came to mind after reading the target sentence. The text was not visible when participants produced their responses. This was done to allow participants to produce content from working memory as opposed to rereading text content (Ericsson & Simon, 1993). In the present study, participants read two texts: one history text (“Louis the XVI and the French Revolution”) with six think-aloud prompts and one science text (“The Power of Erosion”) with seven think-aloud prompts. A practice text was also provided with general feedback that reinforced the instructions.

RSAT uses computational algorithms to assess the extent to which participants’ responses reflected evidence of bridging or elaboration. Content words from the protocols are matched against content words found in the target sentence and the prior text. Words from protocols that match words from the prior text (but not the target sentence) are counted toward a bridging score (e.g., utilizing the word “debt”, which was mentioned in the prior text but not in the current sentence). Words from protocols that do not match words anywhere in the text are counted toward an elaboration score (e.g., referencing “Devil’s Tower”, which was not mentioned in the text). Notwithstanding the simplicity of the scoring algorithms, RSAT scores have been shown to correlate highly with human judgments of the same scores and are predictive of both experimenter-generated and standardized tests of comprehension (see Magliano et al., 2011).

Study Aid Reading Assessment (SARA) SARA (Sabatini et al., 2019) is a computer-based assessment designed to measure proficiency in basic reading processes. In the present study, we used four of six subscales to assess the following: decoding and word recognition, vocabulary, morphology, and sentence processing. An additional subscale assessing reading comprehension as a whole was also used. This served as the comprehension outcome measure in this study. Each subscale has good reliability and the measure has evidence of validity (Sabatini et al., 2019). The word

recognition/decoding measure involved judging if a stimulus was a word, non-word, or pseudo-homophone as quickly as possible. In the vocabulary measure, participants selected an appropriate synonym or topically related word to match a target word. For the measure of morphological processing, participants read sentences and filled in the blank with the correct word form. The sentence processing measure involved selecting the appropriate word to fill in the blank in a sentence. Lastly, the reading comprehension component consisted of short passages associated with multiple-choice questions.

Procedure

The study consisted of two sessions. All measures were accessed through web-links and instructions for each measure were provided on the websites. All participants completed session one in a computer lab with trained study administrators. Some instructors allowed class time for students to participate in the first session while other students completed it outside of class time. For the second session, participants from one institution completed the measures in a computer lab with study administrators present while at other institutions the second session was self-administered with students completing the session on their own outside of class. During the first session, participants completed SARA, followed by RSAT. This session took between 60-90 minutes to complete. After the measures were completed, participants were given information for completing the second session, which took participants approximately 60 minutes to complete. During the second session, participants completed other assessments not used in the current analyses and a demographic questionnaire.

Results

To test for the effect of reading proficiency in the main analyses, SARA subscale scores were entered into a principal components analysis (PCA). The PCA revealed one component, which accounted for 76% of the variance in SARA subscale scores. Separate PCAs were conducted for each subgroup (i.e., race) and found similar relationships between the variables. Therefore, regression scores from the initial PCA (with all readers) were saved and used as a continuous reading proficiency score in the regression models presented here. We refer to the scores derived from the PCA as reading proficiency scores for the remainder of the paper.

Descriptive statistics for RSAT and SARA are listed in Table 1 by group. Correlations between measures are presented in Table 2. In order to test the text and knowledge-based hypotheses among participants who identified with different racial groups, we conducted two hierarchical regression analyses with RSAT bridging and elaboration scores serving as the outcome variables. Racial group was entered first, followed by reading proficiency, each in separate steps. This was done to allow us to view whether differences existed and whether or not accounting for reading proficiency ameliorated these differences. All analyses were

Table 1: Descriptive Statistics by Self-identified Race

	White (N = 95)		Black (N = 160)		Hispanic (N = 45)	
	Mean	SD	Mean	SD	Mean	SD
Decoding/Word Recognition	43.83	6.17	37.20	8.58	39.96	8.59
Vocabulary	30.69	3.60	25.78	5.68	29.22	4.25
Morphology	34.11	3.34	28.94	7.02	31.20	5.80
Sentence Processing	22.69	2.12	19.66	4.51	21.00	3.30
Bridging	1.84	1.18	1.39	0.91	1.57	0.91
Elaboration	3.57	1.20	2.74	1.69	2.78	1.30
Reading Comprehension	14.53	3.66	11.36	4.38	13.42	4.00

Table 2: Correlation Matrix.

	2.	3.	4.
1. Bridging	.38**	.33**	.35**
2. Elaboration		.28**	.30**
3. Proficiency			.70**
4. Reading Comp			--

* $p < .05$, ** $p < .01$

Table 3: Models predicting bridging and elaboration.

	Bridging		Elaboration	
	β	SE	β	SE
Step 1				
Black	-.52**	.13	-.91**	.23
Hispanic	-.31	.18	-.84*	.32
Step 2				
Black	-.25	.14	-.54*	.25
Hispanic	-.20	.18	-.68*	.31
Proficiency	.30**	.06	.41**	.11

* $p < .05$, ** $p < .01$

run using pair-wise deletion. Main effects for the final regression models are presented in Table 3. In terms of bridging, racial group was initially a significant negative predictor for Black participants and a negative, non-significant trending predictor for Hispanic participants ($p = .09$). However, once reading proficiency was added to the model, racial group was a non-significant predictor. In terms of elaboration, racial group was also initially negatively predictive. Unlike bridging, however, racial group remained a significant negative predictor for both Black and Hispanic students, after reading proficiency was added to the model. Reading proficiency was a significant positive predictor of both bridging and elaboration. The adjusted R-squared value for the final models was .11 and .09 for bridging and elaboration, respectively.

An additional analysis was conducted predicting SARA reading comprehension scores. Racial group membership was added first, followed by RSAT scores, and reading proficiency, each in separate steps. The final main effects are

Table 4: Model predicting reading comprehension.

	β	SE
Step 1		
Black	-3.28**	.53
Hispanic	-1.03	.73
Step 2		
Black	-2.42**	.52
Hispanic	-.41	.70
Bridging	.98**	.24
Elaboration	.38*	.14
Step 3		
Black	-.40	.44
Hispanic	.33	.55
Bridging	.43*	.19
Elaboration	.19	.11
Proficiency	2.78**	.21

* $p < .05$, ** $p < .01$

presented in Table 4. Results indicate that bridging was a significant positive predictor of reading comprehension scores, while elaboration was a non-significant predictor ($p = .09$). Although racial group was initially a significant negative predictor of reading comprehension, this effect disappeared once reading proficiency was accounted for. The adjusted R-squared value for the final model was .52.

Discussion

The goal of the present study was to test whether the text and knowledge-based hypotheses helped explain potential differences between students who identified with different racial groups. We contend that doing so yielded insights into the achievement gap. Results supported the knowledge-based hypothesis. Specifically, while controlling for foundational reading skills, group differences remained with respect to elaboration scores. These results are consistent with Magliano et al. (2020) and Feller et al. (2020) who also showed evidence for the knowledge-based hypothesis.

How best, to explain these results? Elaboration involves drawing upon relevant background knowledge and

connecting it to the text (McNamara & Magliano, 2009), and doing so can be challenging for expository text when students lack domain and topic-specific knowledge associated with text (see McCarthy & McNamara, 2021 for an extensive review). We posit that racially marginalized students may be underserved in terms of building the disciplinary specific prior knowledge (e.g., history, biology, physics, chemistry, etc.) needed to establish coherence when reading expository texts. As such, they may arrive at college less equipped to fill in gaps of coherence with background knowledge. This challenge may be related to a myriad of factors associated with the systematic discrimination that exists in the U.S. educational system. Many argue that the achievement gap is better characterized as an “opportunity gap” relating to school funding, teacher training, and wealth/income (Darling-Hammond, 2010; Irvine, 2010; Ladson-Billing, 2013; Martin, Spenner, & Mustillo, 2017; Milner, 2012). In this study, we did not have access to information about educational background factors, however it is worth noting that recruitment for the university involved in this study focused on underperforming urban, suburban, and rural high schools in the regions.

One might also argue that racially marginalized students come to college with *different* background knowledge, rather than *less* knowledge (e.g., Sirin, 2005). Many of the texts used in college courses may be less culturally relevant to students of color (Lee, 2007). As such, the texts and topics may be less aligned with the prior knowledge for these students, making it more difficult for them to make meaningful associations with text content. Prior research suggests that readers rely more on text-based strategies and less on knowledge schemas when they encounter unfamiliar text topics (Alptekin, 2006; Erten & Razi, 2009; Pritchard, 1990).

With respect to the text-based hypothesis, after accounting for variability in reading proficiency, differences in bridging became non-significant for both groups. The present findings suggest that variability in bridging is strongly associated with reading proficiency and may be less directly related to group membership. This makes sense given that bridging involves processing sentences and making connections across the discourse (McNamara & Magliano, 2009).

Results from the present study are consistent with prior research on underprepared college readers. Both Magliano et al. (2020) and Feller et al. (2020) found differences between developmental and non-developmental readers in terms of their propensity to generate elaborative inferences when thinking aloud, but not bridging inferences. This suggested that underprepared college readers in general may come to colleges with deficits in the knowledge that is needed to actively engage disciplinary specific expository text.

The results of the study are also consistent with prior research that showed that bridging and elaboration were predictive of comprehension performance (e.g., Magliano et al., 2011). However, elaboration was not predictive of comprehension performance once proficiency was accounted for in the model. SARA comprehension questions involve

basic inference questions (i.e., inferences strongly implied by text), and therefore the propensity to elaborate may be less necessary to answer them than the propensity to bridge.

A majority of research related to the achievement gap comes from large, standardized tests designed to examine specific reading skills (i.e., vocabulary, morphology) or reading as a whole (i.e., comprehension; NAEP, 2019). The reliance on such high-stakes, standardized testing has been criticized as a form of systemic racism in education (e.g., Au, 2016; 2022). The present study offers a cognitive explanation that goes beyond conclusions that can be derived from high-stakes, standardized tests commonly used in reading research.

With respect to reading comprehension, results indicated that race-based differences in performance did not exist once reading proficiency and strategies were accounted for. One might point out that bridging was a significant predictor of reading comprehension, whereas, elaboration was not. This, however, is likely related to the nature of the comprehension assessment. The reading comprehension measure used here was designed to measure close comprehension of a text (i.e., one’s ability to construct a mental model of the text and answer questions about it). As such, bridging, which involves accurately representing sentences and making connections between them, is directly related to constructing a coherent text-based model of the text. Our prior studies have shown that elaboration scores are predictive of standardized assessments that require complex problem solving (Feller et al., 2020) Reading in college often involves analyzing and assessing a text, rather than merely understanding it (Rouet, Britt, & Durik, 2017). As such, one should not conclude that elaboration is not important for college reading.

Understanding how the cognitive strategies that give rise to comprehension are related to the achievement gap and under preparedness in college is of great importance, and there are important potential implications from this work. Given that knowledge-based inferences (i.e., elaboration) are necessary for academic reading, under prepared students may benefit from instruction targeted at helping them engage relevant prior knowledge while reading. Encouraging students to ground texts in what they already know, using knowledge and language familiar to them to bootstrap the meaning making process, may be valuable, particularly in the context of unfamiliar material (Lee, 2007; McNamara, 2004).

Garth-McCullough (2008) found that middle school students performed better on a comprehension test when the texts were aligned with their cultural backgrounds than when they were not. Moreover, differences in skilled and less skilled readers were significantly smaller when texts were aligned than when they were not. One potential reason for this finding is that alignment supports elaboration when self-explaining texts.

There are several important considerations for future research. First, the version of RSAT used in this study had only two texts. As such, this limits the generalizability of the results. A future study should involve a greater range of texts, and of varying difficulty. Second, an important follow up study to the present study would be to manipulate cultural

alignment of the texts and collect both think-aloud and comprehension measures on the same texts. Doing so would allow an assessment of the extent to which bridging and elaboration are predictive of comprehension (Magliano et al., 2011). Third, one limitation of the present study is that prior knowledge measures related to the text were not collected and should be in future follow-up studies. Studies of this nature would afford testing if domain specific and culturally bound knowledge ameliorates the difference across racial groups for elaboration in a manner similar to adding foundational skills into the model for bridging.

Though tentative, this research suggests that strengthening component reading skills and elaborative inferencing in struggling readers may help mitigate the reading gap that exists between White students and students of color (Craig et al., 2009; Lee, 2015). These results underscore the importance of early, high quality literacy education to support college and career readiness, and a failure to provide that education equitably is arguably a symptom of systemic racism in the educational system (Holland, 2010).

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