



## Cohesion and Coherence-Building in Multiple Document Comprehension

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July 23, 2021

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**Author Note**

The authors declare that there no conflicts of interest with respect to this preprint.

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**Abstract**

We examined the cohesion of readers' constructed responses (i.e., think-aloud, self-explain, or source evaluation responses) while reading multiple documents in relation to source-based essay quality. Natural language processing techniques were used to analyze the cohesion of responses at within- and across-documents levels. Within-document cohesion was negatively related and across-document cohesion was positively related to essay quality. These relations differed by condition: self-explanation and source evaluation produced greater across-text integration than think-aloud.

*Keywords:* comprehension; cohesion; writing; natural language processing

### **Cohesion and Coherence-Building in Multiple Document Comprehension**

Comprehension relies on an individual's ability to create, maintain, and update connections while reading. In multiple document (MD) comprehension, individuals must have the knowledge and strategies to comprehend each document, as well as the skills to evaluate the quality of the sources and integrate information across documents (Braasch et al., 2018; Magliano et al., 2018). In both single and MD comprehension contexts, the degree to which individuals have established connections across multiple pieces of information is indicative of the *coherence* of their mental representation of the text, which has been linked to deeper comprehension (McNamara & Magliano, 2009).

One way that researchers have examined the nature of successful *coherence-building* processes during comprehension is through analyses of readers' *constructed responses* to texts. Recent research suggests that the cohesion of individuals' constructed responses during reading may be indicative of the coherence of their mental representation (Allen et al., 2016, 2015). However, this hypothesis has yet to be investigated in an MD comprehension context where cohesion can be measured both within a single text and across multiple texts. In the present study, we examined three constructed response types that are relevant for MD comprehension: think-aloud, self-explanation, and source evaluation. In traditional think-aloud protocols, readers are intermittently interrupted and asked to report their thoughts as they come to mind; as such, these instructions are relatively neutral in that they do not bias readers to adopt a particular strategy (Pressley & Afflerbach, 1995; Ericsson & Simon, 1984).

MD tasks require readers to represent important relationships conveyed both within and across texts (Rouet & Britt, 2011). Self-explanation is one strategy that may help readers make these connections. Self-explanation involves monitoring your own understanding and explaining

the text to yourself as you read. Engaging in self-explanation can lead to increased inference generation and connections to prior knowledge, which supports deeper comprehension (McNamara, 2004). Finally, theories of MD processing emphasize the importance of sensitivity to document *sources* (i.e., sourcing) as an important process for comprehension (Braasch & Bråten, 2017)—this process involves the evaluation of the aspects of sources, such as authors, their credentials, and the publisher. Sourcing is seen as important for MD processing because there are often dramatic differences in the reliability of the sources that are encountered in MD tasks. Therefore, one method that has been investigated for improving MD comprehension is instructing readers to pay attention to and evaluate source information as they read (Braasch & Bråten, 2017).

Cohesion analyses may serve as a powerful method for elucidating processing differences that may emerge from these three reading tasks (Gernsbacher, 1990; McNamara et al., 2014). In the current study, we aimed to answer two primary research questions. First, *how do the within- and across- document cohesion indices in participants' constructed responses relate to the overall quality of participants' post-reading source-based essays?* We also manipulated reading instructions to generate a variety of types of processes that readers engage in during both single and multiple-document comprehension tasks. Thus, a second research question was: *To what extent do different comprehension strategies (i.e., constructed response instructions) influence the relation between the cohesion in the responses and source-based writing quality?*

## Method

### Participants

Participants ( $n = 95$ ) included 46 high school students ( $M_{age} = 16$ ,  $SD_{age} = .99$ ) who participated in the study in the Summer of 2019 and 49 college freshmen students who had

graduated high school the previous year ( $M_{age} = 18$ ,  $SD_{age} = .89$ ) and participated in the Fall of 2020. All participants were native speakers of English. Data for two participants were removed from the analyses for failure to follow instructions, leaving 93 participants in the final analysis.

## **Materials**

### ***Constructed Response Instructions***

Participants were assigned to one of three instructional conditions; think-aloud, self-explanation, and source evaluation. Participants in the think-aloud condition were asked to “report their thoughts” as they read through the texts. Participants in the self-explain condition were asked to try to explain the text to themselves as they read. Participants in the source evaluation condition were asked to reflect on the source (i.e., author, publication, date/locations, audience) of the text while they read.

### ***Document Sets***

Each document set contained four texts; one set was focused on the effects of global warming and the other was focused on cell phone use. The presentation of the texts was counterbalanced and randomly assigned. For the global warming set, there were two texts that discussed whether the causes of global warming were natural or manmade and two that discussed the negative and positive consequences of global warming. For the cell phone use set, two of the texts focused on the argument that cell phone use could increase cancer risk and two discussed the argument against radiation from cell phone use causing cancer.

At pre-determined sentences (6-9 sentences in each document), participants were prompted to generate their constructed response (e.g., think-aloud, self-explanation, source evaluation).

### ***Source-Based Essay***

After reading the document sets, readers were asked to write an essay that either 1) explained the effects of climate change for life on earth and the extent to which humans are responsible or 2) explained the effects of cell phones on humans and the extent to which cell phone use poses health risks. Participants were asked to elaborate on the information in the text instead of summarizing. They were also asked to use information from the texts to support their ideas, but to put ideas in their own words.

### **Procedure**

Participants completed the study in the context of the MD module of iSTART (McNamara et al., 2004). They completed two MD tasks on different topics (global warming, dangers of cell phone use). In each task, they read four texts and then wrote an essay. Before reading, participants were given a chance to skim the texts before engaging in the deeper reading process. During the actual reading portion of the experiment, participants were prompted to *think-aloud* ( $n = 30$ ), *self-explain* ( $n = 32$ ), or *evaluate the sources* ( $n = 31$ ). They were then given 25 minutes to write a source-based essay. In a second session, they completed the same reading and writing task with the alternate text set.

### **Analyses**

#### ***Automated Cohesion Analyses***

To prepare participants' constructed responses for cohesion analysis, we aggregated the responses in two different ways: within-document (all constructed responses for a given text) and across-document (all constructed responses for a given document set). Participants' constructed responses were analyzed using TAACO (Crossley et al., 2018). For the purposes of the current study, we selected indices that were representative of lexical cohesion at within- and across-document set levels. For each level, we looked at four types of cohesion: *all words*, *content*

*words (i.e., nouns, verbs, adjectives, adverbs), arguments (nouns, pronouns), and verbs.*

Cohesion measures index the overlap between these parts-of-speech between sentences within the texts and across the texts.

### ***Source-based Essay Quality***

The essays were evaluated using a scoring rubric that included four analytic scores and one holistic score. Human ratings for the scores were provided by two teams of two expert raters each. After adjudication, all Kappa scores were greater than .6. Here, we focus only on the holistic scores, which ranged from 1 (very poor) to 6 (excellent).

## **Results**

For all participants, we collapsed the cohesion and essay scores across document sets. Thus, each participant had an average set of cohesion indices as well as an average essay score. Holistic essay scores did not differ based on instructional condition. Our first research question considered whether the within- and across-document cohesion of participants' constructed responses were related to the overall quality (i.e., holistic score) of their essays. Pearson correlations revealed that connections made at the individual document level (within-text cohesion) were negatively related to essay scores (See Table 1 for correlations). Conversely, across-document cohesion indices were positively correlated with essay scores, suggesting that connections made across documents in the document set were indicative of higher quality source-based essays.

**Table 1**

### ***Correlations Between Lexical Cohesion and Holistic Essay Quality***

Index	Within	Across
All Words	-0.21*	0.33**
Content Words	-0.22*	0.31**



Arguments	-0.23*	0.30**
Verbs	-0.18	0.27**

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\* $p < .05$ ; \*\* $p < .01$

We conducted a linear model to predict essay scores from the within- and across-document cohesion indices. For this model, we selected only the two indices (*content word* and *argument*) with the highest correlation from each of the within- and across-text cohesion groups. Overall, the cohesion of participants' constructed responses was predictive of their source-based essay score ( $R^2 = .19$ ,  $F(2,90) = 10.34$ ,  $p < .001$ ). Importantly, within- and across-document cohesion exhibited different patterns of relations with essay quality. Connections made across the document set were positively related to essay quality, whereas within-document cohesion was negatively related to quality.

Our second research question regarded whether the relations between the within- and across-document cohesion and essay scores were moderated by instructional condition. Group-level correlations indicated that there were differential relations between cohesion indices and essay quality as a function of condition. For within-document cohesion, only the think-aloud condition exhibited a significant moderate negative relationship with essay quality (see Table 2). For across-document cohesion, the self-explanation and source evaluation conditions exhibited significant positive correlations with essay quality, whereas the think-aloud condition did not. In a follow-up analysis, the interaction between cohesion indices and condition did not reach significance for either within- ( $p = .45$ ) or across-document cohesion ( $p = .40$ ). There was, however, a significant difference in the simple slopes for the think-aloud condition for within-document cohesion ( $p = .05$ ; see Figure 1). For across-document cohesion, the simple slopes for self-explanation and source conditions were significant ( $p = .04$  and  $p < .01$ , respectively; see

Figure 2). These results indicate that the negative influence of local connections was most predictive of essay quality for the think-aloud condition while across-document connections were most predictive for the self-explanation and source-evaluation conditions.

**Table 2**

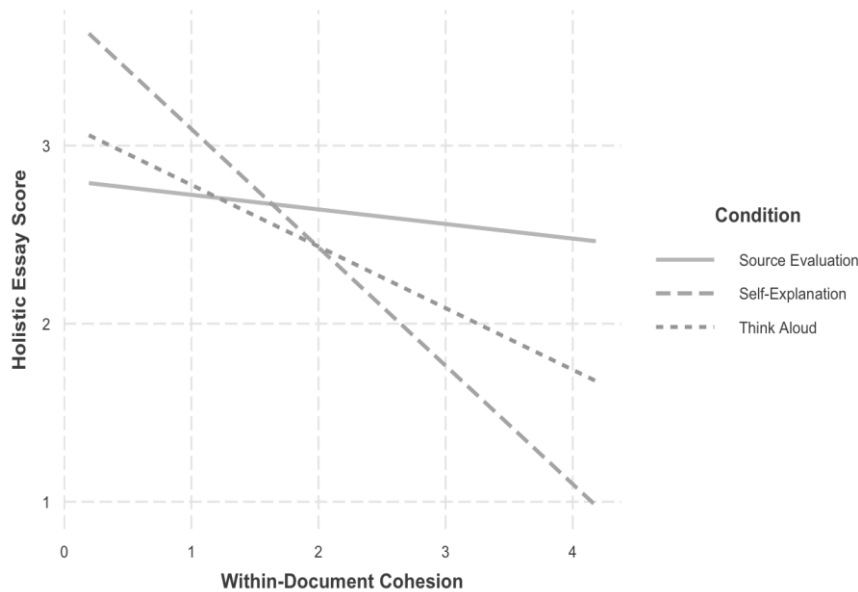
*Group-Level Correlations Between Lexical Cohesion and Holistic Essay Quality*

Condition	Within	Across
Think-Aloud	-0.40*	0.14
Self-Explain	-0.24	0.35*
Source Evaluation	-0.03	0.48**

\* $p < .05$ ; \*\* $p < .01$

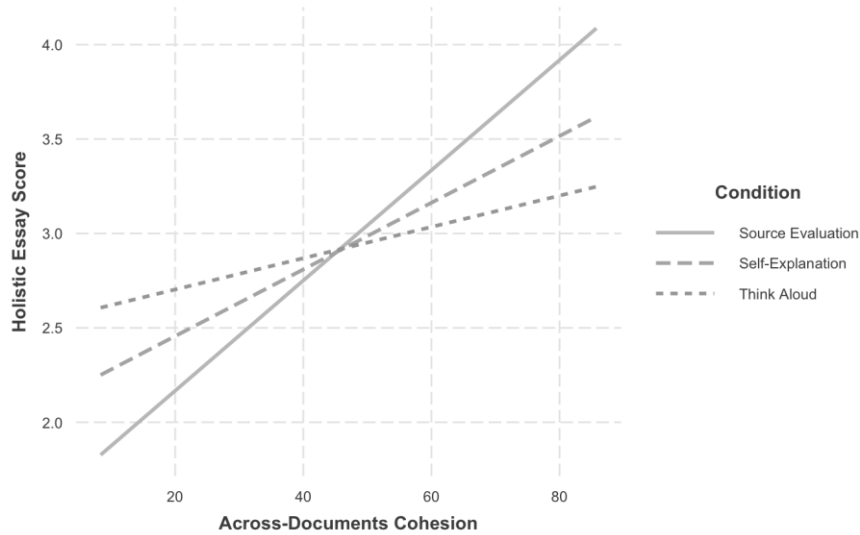
**Figure 1**

*Simple Slopes of Within-Document Cohesion Predicting Holistic Essay Score by Instructional Group.*



**Figure 2**

*Simple Slopes of Across-Document Cohesion Predicting Holistic Essay Score by Instructional Group.*



### Discussion

We examined relations between within- and across-text cohesion and source-based essay quality. In response to our first research question, we found that the cohesion of participants' constructed responses was related to essay scores. Importantly, across-document cohesion was positively related to essay quality while within-document cohesion was negatively related. One interpretation of this finding is that participants who had higher levels of within-document cohesion of their constructed responses were comprehending the texts in isolation, rather than creating an integrated mental representation between documents. In response to our second research question, the relation between cohesion and essay quality varied across conditions. The negative relationship between within-text cohesion and essay performance was present in the think-aloud condition, suggesting that thinking aloud may have encouraged readers to focus on comprehending the texts in isolation. Conversely, across-document cohesion was positively correlated with essay scores in the self-explanation and source evaluation conditions. These instructions may have more effectively oriented participants to engage in the within-text integration necessary to write effective essays. Overall, these findings provide a theoretical link

between cohesion and coherence and suggest that cohesion cues in constructed responses can potentially provide a proxy for coherence-building processes during reading.

### **Acknowledgements**

This research was supported in part by IES Grants R305A180261, R305A180144, and R305A190063 as well as the Office of Naval Research (Grants: N00014-17-1-2300 and N00014-19-1-2424). Opinions, conclusions, or recommendations do not necessarily reflect the view of the Department of Education, IES, or the Office of Naval Research.

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