PROCESS-ORIENTED ASSESSMENT TOOLS FOR STUDYING SECOND GRADERS' INFORMATIONAL COMPREHENSION

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ABSTRACT

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This dissertation includes two manuscripts that resulted from a single study that examined two process-oriented assessment tools for informational reading comprehension. While verbal protocol methodology has contributed greatly to our understanding of how adult readers comprehend, currently no researchers have utilized verbal protocols to study how readers in the primary grades comprehend informational texts. Recently, the Concepts of Comprehension Assessment (COCA), another process-oriented assessment tool, has been developed to provide insights into how first and second graders comprehend informational texts. Thirty second graders in five classrooms in five elementary schools participated. The study involved a within-subjects design that first involved students thinking aloud as an informational text was read to them and then completing the COCA. Modified grounded theory analysis was employed to create an inventory of the comprehension processes that the students reported in the verbal protocols. The inventory resulted in 23 processes.

The first manuscript focuses on comparing the COCA and the verbal protocols and addresses the following research questions: 1) In what ways are our insights into informational reading comprehension similar when using the COCA and verbal protocols; 2) What does each tool uniquely contribute to our understanding of second graders' informational reading comprehension; and 3) What do verbal protocols tell us about second graders' comprehension processing of informational texts?

To address these questions the analysis focuses on a) a comparison of the processes measured by the two tools, b) an item-analysis and, c) a comparison of the verbal protocol composite scores to the COCA total scores. Results of this study reveal that second graders utilize a range of processes, including some highly sophisticated comprehension processes, when comprehending informational text. While the study shows considerable overlap between the COCA and the verbal protocols in the information they provide, each tool provides unique insights as well.

The second manuscript focused solely on the verbal protocol data and was based on the inventory of processes. The study identified different profiles of comprehension among second graders reading informational text. These processes were employed in meaningfully different amounts and patterns across verbal protocols. Specifically, data reveal six distinct reading profiles: *Active Processors, Active Processors with a Foundation Process(es), Single Processors, Active and Superficial Processors, Single Superficial Processors,* and *Passive Processors*. The *Active Processor* profiles are characterized by flexible utilization of a wide range of strategies and active construction of meaning. Single Processor profiles were dominated by a single process. *Superficial Processor* profiles made many repeating or irrelevant comments. Finally, *Passive Processors* reported a low level of cognitive and affective activity and failed to use a wide variety of processes. Identifying reading profiles may help teachers to group students and tailor instruction to their comprehension strengths and weaknesses. Researchers might use results of this study to better understand how informational reading comprehension develops in primary grade readers by identifying different paths and levels of sophistication in development.

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Introduction

Investigating the comprehension processes that young readers utilize has been the driving focus on my graduate career. I have attacked this issue from three related directions. First, I have examined the challenges and successes that teachers face as they begin to implement effective instructional practices that are geared toward improving their students' comprehension (Hilden & Pressley, 2007). Second, I have examined how verbal protocol methodology can inform the field about students' developing comprehension processes (Hilden, 2006; Hilden & Pressley, 2002). Third, I have been a part of a research team that has designed and tested two assessments that focus on informational text comprehension in the primary grades, the Concepts of Comprehension Assessment (COCA) and the Informational Strategic Cloze Assessment (ISCA) (Billman, Duke, Hilden, et. al, 2008; Hilden, Duke, & Billman, et. al, 2008). My dissertation work flowed naturally from the intersection of these last two directions. My past verbal protocol work was done solely with narrative texts. I was curious as to what verbal protocols could tell us about informational text comprehension of young readers. Also, I was intrigued with the possibility of studying how the COCA and verbal protocols would compare with one another since both are process-oriented tools.

Overview of the Dissertation

I wrote this dissertation using an alternative format (Duke & Beck, 1999). The dissertation consists of an Introduction and two manuscripts that are ready to be submitted for publication in scholarly journals. In the following, I will briefly describe the dissertation study as a way to provide a frame of reference for the two manuscripts.

Overview of the Study

When designing the study, I had two primary purposes in mind. First, I wanted to compare the COCA and verbal protocols. Second, I wanted to study what verbal protocols tell us about second graders' comprehension processing of informational text. These tools are uniquely situated to fill in a gap in the field's knowledge about how reading comprehension develops for primary grade students' reading of informational text. Because they are both process-oriented tools, they can provide a clearer picture of the cognitive and affective processing of second graders as they are read informational texts. As a result, the first manuscript, *A Comparison between Verbal Protocols and the Concepts of Comprehension Assessment*, addresses the following three research questions: 1) In what ways are our insights into informational reading comprehension similar when using the COCA and verbal protocols; 2) What does each tool uniquely contribute to our understanding of second graders' informational reading comprehension; and 3) What do verbal protocols tell us about second graders' comprehension processing of informational texts?

As I was analyzing the verbal protocols for the first manuscript, I noticed that the students processed the informational texts in significantly different ways. After further investigation, it appears that there are different profiles, or ways of actively processing text, when second graders encounter informational text. Therefore, the research question for the second manuscript, *Profiles for informational text comprehension in second grade*, is "what are different profiles of informational reading comprehension in second grade?" In this way, the second manuscript is an extension of the final research question from the first manuscript.

Thirty second graders in five classrooms in five elementary schools participated. The study involved a within-subjects design. In the first session, students were trained to think aloud to a puzzle activity and then thought aloud as an informational text was read to them. The students then completed the COCA during the second session. Analysis began with a modified grounded theory analysis (Strauss & Corbin, 1990) to construct an inventory of comprehension processes from the verbal protocols. The final inventory consisted of 23 processes.

In the first manuscript, I examined which processes overlapped and which processes were uniquely measured by each tool. I then conducted an item analysis, which involved analyzing students' comments during the verbal protocols for pages where there are COCA items. Finally, I calculated the composite score for the verbal protocols. These composite scores were based on three measures: the total number of processes reported, the range in the number of different processes reported, and a quality score. I then correlated the COCA and composite scores for the verbal protocol scores. Results showed that second graders apply a wide range of processes when an informational text is read to them. The study also shows considerable overlap between the COCA and the verbal protocols when it comes to measuring *comprehension strategies, text features, and processing graphics*. However, each tool provides unique insights as well. For example, the COCA captures vocabulary better, whereas the verbal protocols do a better job of revealing monitoring and affective processes.

In the second manuscript, a rubric of different reader profiles was created once the verbal protocols had been coded using the inventory discussed above. The rubric distinguishes between six reading profiles: *Active Processors, Active Processors with a*

Foundation Process(es), Single Processors, Active and Superficial Processors, Single Superficial Processors, and *Passive Processors*. The *Active Processor* profiles applied a wide range of processes, both in type and quantity. The protocols of *Single Processors* were dominated by a single process. *Active and Superficial Processors and Single Superficial Processors* profiles made many repeating or irrelevant comments. Finally, *Passive Processors* reported a low level of cognitive and affective activity and failed to use a wide variety of processes. In addition to providing detailed descriptions of the profiles, I also discuss potential instructional implications for working with these different types of reading profiles.

The study's conclusions have potential significance in several related areas. Among the most important are the following three areas. First, the results will contribute to the field's growing understanding of informational reading comprehension in the primary grades. Second, this study has implications for literacy instruction. Research has shown teachers typically teach what they assess (e.g., Fredericksen & Collins, 1989). This is problematic as we do not want primary grade teachers to think that they need not focus on informational text until the later grades. This study calls much-needed attention to assessment tools for informational reading comprehension and about variation in reading profiles of informational reading comprehension. Finally, this study provides valuable information about and future directions for developing verbal protocol methodology. This methodology that has not typically been used with students in the early elementary grades, but as is clear from this dissertation, can offer many insights for this age group.

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MANUSCRIPT ONE: A COMPARISON BETWEEN VERBAL PROTOCOLS AND THE CONCEPTS OF COMPREHENSION ASSESSMENT

Many of us in the field agree that comprehension can be defined as "the *process* of simultaneously extracting and constructing meaning through interaction and involvement with written language" (p. 11, RAND Reading Study Group, 2002; my emphasis). This is not to say that reading comprehension is not also an outcome. In fact, most of the assessment tools that we have today operationalize reading comprehension as what a student can remember via retelling or question-answering after reading. The end goal of reading comprehension is certainly important in order to achieve success not only in school but also in our lives. However, if reading comprehension is not just an outcome, but rather an active, constructive process, then it makes sense to investigate these internal mental processes which influence the outcome. Studying these internal processes is particularly important if the goal is to improve comprehension instruction. Knowing that a student struggles with comprehension is not enough. In order to be able to remedy the comprehension problems through instruction, it is necessary to understand the students' processing issues that underlie the comprehension difficulty. However, studying these invisible mental processes presents an interesting methodological issue. Most researchers have gotten past the behaviorists' belief that because mental processes reside in the black box of the mind, they are therefore unworthy of study (Friedenberg, 2005). However, the puzzle remains—how are we to make the invisible visible?

What We Know About Adult Reading Comprehension

In the past couple of decades, much of what we know about reading comprehension as a process has come from verbal protocols of adult readers. In their

landmark work which synthesized the extant verbal protocol work in reading comprehension, Pressley and Afflerbach (1995) concluded that adult, expert comprehenders are constructively responsive when they read. This means that expert comprehenders flexibly apply a repertoire of strategies before, during, and after reading in response to various text factors (e.g., text difficulty, text topic, and the genre of the text) and the purpose for reading. In this study, I defer to Pressley, Harris, and Marks' (1992) definition of strategies as "goal-directed, cognitive operations employed to facilitate performance" (p. 4). In addition to flexible strategy use, Pressley and Afflerbach found that rich construction of meaning also involves monitoring and evaluative processes (1995).

Verbal protocols also revealed that as expert readers, we do not passively internalize the texts and images on the page. Instead, we transact with the text by actively evaluating, interpreting, reacting and relating to what we read (Rosenblatt, 1978). Additionally, this transacting with the text is not only a cognitive process but an affective one as well (Afflerbach, 2008; Pressley & Afflerbach, 1995; Rosenblatt, 1978). While this is perhaps easier to imagine with a narrative text, it can also be true for informational text (Alexander, 1997). Imagine reading about the life cycle of the praying mantis and finding oneself disgusted after reading how the female bites the head off of the male after mating! This meaning construction in adults is also affected by the purposes for which we read (RAND Reading Study Group, 2002). For example, when reading an informational text, we may skim or read deeply and thoroughly depending on whether the text is answering our questions or not.

The research that compares effective and ineffective readers has also contributed much to our understanding about the mental processes and strategies that lead to effective comprehension outcomes (see Duke, Pressley, & Hilden, 2004 for a summary). For example, we know that struggling readers are not as active when they process text. In comparisons of novice and expert readers, we find that expert readers apply a more flexible repertoire of strategies than do novices and use the strategies more effectively (Lundeberg, 1987; Peskin, 1998). Researchers have found that poorer readers make fewer explanatory inferences that further their understanding of text than their more skilled counterparts (Laing & Kamhi, 2002; Yuill & Oakhill, 1991). The prior knowledge of the topic being read not only affects our outcomes of comprehension, it also affects how we process a text (Anderson & Pearson, 1984). A lack of prior knowledge impacts readers' abilities to effectively make inferences, make predictions, and use imagery; these skills are all affected by how much we know about a topic (Duke, Pressley, & Hilden, 2004; Pressley, et. al, 1992). However, a characteristic of poor readers is that they often fail to activate the prior knowledge they have or, instead, they connect to a text with prior knowledge that is tangential at best (Williams, 1993). In summary, we know that when adults and older students read, their comprehension processes and outcomes are affected by many individual factors such as readers' capacities, abilities, prior knowledge and experience. However, this research has been done primarily with adults with a few studies of upper elementary grade and high-school students (e.g., Laing & Kamhi, 2002; Williams, 1993). We actually know very little about the comprehension processes that young children employ when reading.

Developing Reading Comprehension

Improving students' reading comprehension is currently a hot topic for researchers (Cassidy & Cassidy, 2008) and in our schools. It is also one of the five pillars of the National Reading Panel Report (2000). While we know a lot about various predictors and factors that are associated with comprehension as an outcome, not nearly as much research attention has investigated reading comprehension as a process. A great deal of research on comprehension and young children has focused on teaching students strategies and then seeing how this improves children's comprehension as an outcome. Indeed, it is clear from the research that teaching students comprehension strategies improves their understanding and memory of text (for summaries see Pearson & Duke, 2002; National Reading Panel, 2000). Little research has looked at how teaching these strategies affect the online comprehension process *as* they read (see Brown, Pressley, Van Meter, & Schuder, 1996, for an exception). Very few researchers in the past have asked primary grade students, "What are you thinking about?" when the students are reading or used other approaches to investigating these online comprehension processes.

Verbal Protocols & Developing Readers

Researchers conduct verbal protocols to gain information about participants' cognitive processes by having them verbalize their internal states and behaviors while performing a task (Ericcson & Simon, 1984). Messick (1989) proposed that verbal protocols, with the insight they provide into mental processes, represent one way to establish substantive validity (i.e., whether participants actually engage in the theorized processes measured by an assessment). Typically, verbal protocols involve participants verbally reporting what they are thinking as they perform a task. It is the researcher's job to infer the cognitive processes underlying participants' behaviors and reported thinking.

Ericcson and Simon (1984) provide a history and standards of excellence for verbal protocol methodology. Researchers have also provided recommendations for conducting verbal protocols to study reading comprehension (Afflerbach, 2000; Pressley & Afflerbach, 1995; Pressley & Hilden, 2004).

While verbal protocol methodology has greatly informed the field about how adult readers understand text, this methodology has not been used to deepen our understanding of the reading process of readers in the primary grades. One reason for the lack of protocol studies with younger students is the assumption that developing readers are unable to provide useful verbal protocols. Afflerbach and Johnston (1984) reasoned that because verbal ability is confounded with reading ability, younger and less verbal participants may produce poor think-alouds. Moreover, verbalizing their thoughts while reading is thought to overwhelm their cognitive resources, and therefore, this methodology would not provide an accurate portrayal of their naturally occurring reading comprehension. Afflerbach and Johnston (1984) further stated that young readers may not provide accurate think-alouds because they may not have sufficient metacognitive awareness of what they are thinking while reading.

However, despite these trepidations, Afflerbach (2000) called for future studies to investigate the developmental nature of reading comprehension using verbal protocols. This would presumably include primary grade children. While the reasons discussed above discourage employing verbal protocol methodology with young students, anecdotal evidence exists from teachers who claim that first and second grade readers can not only be excellent comprehenders, but can verbalize and discuss the different strategies they used to make sense of texts (Harvey & Goudvis, 2000; Keene & Zimmermann, 1997;

Miller, 2002). For example, Miller writes about her first graders who discuss with one another different types of connections to their background knowledge that they make while reading (2002). Keene and Zimmermann (1997) even provide a rubric for assessing students' think-alouds at the end of their book. Unfortunately, none of Keene and Zimmermann's work on think-alouds has been empirically tested to date.

In addition to anecdotal evidence, preliminary research suggests that second graders can verbalize their thoughts while reading when fluency and decoding demands are low for students (Brown, Pressley, Van Meter, & Schuder, 1996). The researchers compared the verbal protocols of second graders who had experienced traditional reading instruction to transactional strategies instruction (TSI), a form of comprehension instruction for reading. They triangulated the verbal protocol analysis with analysis of retellings and standardized assessments. Brown and colleagues concluded that verbal protocols data converged with the other measures that found that TSI improved reading comprehension over more traditional instruction. Verbal protocols in this study also helped answer the more important question of why. This study also provides initial evidence that second-graders can report their strategy use.

Hilden and Pressley (2002) found a first grade teacher whose students were able to verbalize a rich repertoire of strategies when reading familiar books during a think-aloud. In fact, her students, with minimal prompting, made as many strategic comments as the fourth graders in the study.

Hilden (2006) collected verbal protocols from 24 second graders who read at or above grade-level. These students read aloud and verbally reported their thoughts and feelings while they read one of five narrative picture books. Grounded theory analysis

(Strauss & Corbin, 1990) resulted in a comprehension processes inventory that consisted of 7 categories of processes: inferences, connections, and predictions (ICP), questioning, monitoring, picture strategies, evaluations, synthesizing, and affective comments. Among other findings, Hilden discovered that unlike their adult counterparts, only a minority of these younger readers actively constructed meaning before or after reading. The vast majority of their comments occurred while reading.

Currently, no researchers have employed verbal protocols to study how primary grade students comprehend informational texts. This is an important distinction as there is research evidence that suggests genre impacts the way we process when we read, both for adults (Kucan & Beck, 1997; Pressley & Afflerbach, 1995) and children (e.g., Duke, Pressley, & Hilden, 2004; Hidi & Hildyard, 1983; Langer, 1996).

Additionally, researchers have not systematically examined how verbal protocols compare to other comprehension measures (one exception is the previously discussed work of Brown et. al, 1996), as previously called for by Pressley and Afflerbach (1995). In conclusion, while verbal protocols seem to offer a promising tool for studying reading comprehension processes in young readers, additional research exploring the utility of verbal protocols with this population is needed, particularly with informational texts.

Concepts of Comprehension Assessment

Recently, the Concepts of Comprehension Assessment (COCA), a new and unique assessment tool, has been developed to provide insights into first and second graders' comprehension processes (Billman, Duke, Hilden, et. al, 2008). This assessment does not use verbal protocol methodology. Rather, the COCA administration involves asking questions or having students fill in blanks as the book is read to them in order to

reveal more about their online construction of meaning. One way that the COCA is distinctive is that performance does not depend on children's word recognition ability as the text is read aloud to students. However, the COCA is not a traditional listening comprehension task in that students look at the book as it is read to them and respond to items, many of which cannot be solved by simply listening to the text alone (e.g., reading the index, or questions regarding graphics). This assessment is also unique in its focus on informational text within the domain of the life sciences (Billman, Duke, Hilden, et. al, 2008).

The COCA assesses four contributors which are thought to influence informational reading comprehension. These four contributors are: *text feature knowledge* (e.g., reading and interpreting table of contents, index, & labels), *processing graphics*, *vocabulary,* and *comprehension strategies*. Within the *comprehension strategies* contributor, the authors of the COCA specifically chose four comprehension strategies to represent the larger range of strategies: predicting and previewing, integrating prior knowledge, inferring (as a conscious strategy rather than that which occurs automatically), and summarizing. Graphics such as diagrams, tables, and maps, have been identified as an integral part of informational texts (Duke & Kays, 1998; Purcell-Gates & Duke, & Martineau, 2007). The *processing graphics* contributor then refers to students' understanding of graphics or illustrations. The *text feature* contributor measures students' abilities to recognize and use navigational text features (e.g., table of contents, index) as well as other text features common to informational texts (e.g., labels, captions, pronunciation guides). The *vocabulary contributor* consists of two related types of subcontributors. The first subcontributor is knowledge of high-utility words such as

observe, *describe*, *cycle*. Knowledge of these words is obviously important to informational comprehension across a wide range of topics and texts and varies by readers (similar to what Beck, McKeown, and Kucan, 2002 call Tier II vocabulary primarily in reference to narrative text). The other subcontributor of vocabulary assessed by the COCA is the ability to glean word meaning from text. Examples of this subcontributor include recognizing when the text provides a definition of the word and gleaning word meaning from the glossary. Such vocabulary strategies are important in informational texts, in which the reader is likely to encounter many unfamiliar words (Hiebert, 2008). These four contributors were chosen based on either past research support or because they have been hypothesized to be causally related to informational reading comprehension. Additionally, the COCA authors chose to focus on these contributors because they are amenable to teachers' instruction. Other factors, such as working memory, are associated with reading comprehension but do not seem as easily remediated (Pressley, et. al, in press). Still other factors, such as word recognition and fluency, were not measured by the COCA because they are adequately measured in many other current reading assessments.

Process-oriented measures, like the COCA, contrast with traditional comprehension assessments that are typically outcome or product-based, such as recall measures and answering questions about a text (e.g., the Gates-MacGinitie Test of Reading Achievement, MacGinitie, MacGinitie, Maria, Dreyer, & Hughes, 2000; the Basic Reading Inventory, Johns, 1997). These product-based measures occur after one finishes reading. Thus, while such measures provide information about how well a reader comprehended a text (outcome-focused), they do not reveal how or why that particular

understanding resulted (process-focused). One exception is the Qualitative Reading Inventory-4 (Leslie & Caldwell, 2006). This informal reading inventory has an option for think-alouds that has teachers categorize students' verbal responses on eight categories. However, these think-alouds are only available for grades six and higher and evidence of validity and reliability is not reported.

Purpose of the Study

The dual purposes of this study are to explore 1) what the COCA and verbal protocols tell us about second graders' comprehension processes of informational text, and 2) how these two tools compare. Given a theoretical framework that emphasizes the process-oriented nature of reading comprehension, verbal protocol methodology seems particularly well-suited to the study of active meaning-making construction involved in reading comprehension as the methodology provides a window into how the mind processes text. The same holds true for the COCA as it was designed for a diagnostic function that would provide teachers with information about how students are and are not processing informational text. Both of these tools are in a unique position to fill in a gap in the field's knowledge about how reading comprehension develops, particularly for primary grade students' reading of informational texts. While some comprehension outcome measures, like retellings, can reveal problems with comprehension strategies, verbal protocols and the COCA were designed to more clearly capture readers' strengths and weaknesses as students construct meaning from texts. In other words, these tools attempt to address the question: where did their comprehension processes break down and what were the strategies and processes they used while reading? These questions have important implications not only for understanding reading development but for how

teachers meet the immediate learning needs of their students through scaffolded instruction.

Specifically, in this study, I will address three related questions: 1) In what ways are our insights into informational reading comprehension similar when using the COCA and verbal protocols; 2) What does each tool uniquely contribute to our understanding of second graders' informational reading comprehension; and 3) What do verbal protocols tell us about second graders' comprehension processing of informational texts?

Methods

In order to compare the verbal protocols and the COCA tools, I employed a within-subject design in which students first thought aloud and then completed the COCA. First, I examined what each tool revealed about the comprehension processes of second graders. This involved looking at what processes are revealed in both the verbal protocols and the COCA and which are unique to each. Secondly, I compared how well the verbal protocols and the COCA scores aligned. Also, I did an item-by-item analysis on the COCA and verbal protocols. This involved looking at the pages in the books where there are COCA questions to see what students are doing on the verbal protocols. (For example, when the COCA asked students a *processing graphics* item, did students typically make *processing graphics* comments on the same page during the verbal protocols, or did they comment about something else, or did they say nothing at all?)

Participants

This study involved 30 second grade students, 11 boys and 19 girls. Teachers in five classrooms ranked all of their students on a continuum according to their perceptions of the students' informational reading comprehension. Within each classroom, I divided

all of the consenting students into six ascending ability groups, from highest to lowest perceived ability, and randomly sampled one student from each group. (See Tables 1 and 2 for school demographics.) The rate of parental consent for three of the rooms was 55%. (I was not able to attain the consent rate for the other two classrooms at the time of submitting the dissertation). The classes were part of a larger study examining the validity and reliability of the COCA. The schools for the larger COCA study were selected to represent a range of school settings in terms of demographics. The participating classrooms in this study were selected with this same end in mind. The teachers and administrators were chosen because they had previously indicated their interest in either participating in research concerning informational text comprehension or learning more about the COCA more specifically. Three students were English Language Learners and none of the students received special education services at the time of the study.

Data Collection Procedures

The students participated in two individual sessions. In the first session, the students were trained in the verbal protocol procedure and produced a verbal protocol of one of the COCA books. During the second session, a research assistant administered the COCA with the other book. I chose not to counterbalance the order of verbal protocols and the COCA because I did not want the students' experiences with the COCA to unduly influence how students responded during the verbal protocols. There was a possibility that the COCA questions on the four contributors could influence the types of processes that students reported during the verbal protocols. For example, students might be more likely to report *processing graphics* processes after being asked multiple

questions that call their attention to graphics in the COCA. However, there seemed to be less of a chance of the verbal protocols influencing the COCA since the prompts and cues were so general (see discussion below for description of prompts).

First Session. The first session began when I introduced the think-aloud procedure by having students think-aloud while solving a 3-D puzzle. At the introduction, students were asked to talk about whatever they were thinking as they attempted to solve the puzzle. If students did not independently verbalize, they were cued to say what they were thinking or feeling approximately once a minute for five minutes. (See Appendix A for the complete think-aloud protocol.) The training activity was followed by a brief set of directions for thinking aloud with the book, which can be found below:

> Now before we start, I have some directions. What I am really interested in is hearing your thoughts and feelings about the book as I read it to you. So just like the puzzle where you told me what you were thinking and feeling, I want to know what's going on inside your mind as you read. You can stop and tell me what you are thinking whenever you want. That is okay. Remember, just like the puzzle, there are no right or wrong answers. Also, do you see these yellow dots? I will stop and ask you to tell me what you are thinking and feeling when I get to each yellow dot. Sometimes there may be places where the book is not making you think or feel anything. If this happens you can shake your head no or tell me that you are not thinking anything and we will go on. Also, it is okay if you want to flip through and look at pages. Finally, if you want to hear any of the pages again just ask and I will reread the page to you. Can you tell me

the directions so that I know you understand please? (Clarify any misconceptions and review directions as needed.)

When listening to students repeat the directions, I checked to see that three main points were captured: 1) the student can think aloud at any time, 2) the student should either think aloud after yellow dot or say, "I'm not thinking anything" and, 3) the student can ask to reread.

After reading the directions for thinking aloud, I read either *Salmon* or *Dragonflies* to the students. Book selection for the verbal protocols was randomly counterbalanced within and across classrooms, with roughly equal numbers of students experiencing each form in the first session. Students were cued to think aloud on each page. Each page was marked with a yellow dot in the bottom outside corner (this "yellow dot" method has been employed in past verbal protocol work, e.g., Olshavsky, 1976-7) and served as a nonverbal reminder to think-aloud before a student went onto the next page. If students did not automatically think aloud at the yellow dot, I asked them, "What are you thinking or feeling?" or directed them to "Think aloud for me." (This does not match the COCA assessment, in which students are not asked questions on every page. However, this cueing decision still allows for a page-by-page comparison between the COCA and verbal protocols, while allowing for additional data from the pages that do not have COCA items.) This type of nondirective prompt has been used successfully in past research and is done in order to cut down on the influence that the researcher has on the participants' verbalizations (e.g., Bereiter & Bird, 1985; Lundeberg, 1987; Myers, Lytle, Palladino, Devenpeck, & Green; 1990; Olshavsky, 1976-7; Wyatt, Pressley, El-Dinary, & Stein, 1993).

There were several situations in which follow-up prompts were given. First, I used follow-up prompts in order to clarify what a student was trying to communicate in order to better understand the underlying processes. For example, when a student commented that, "I'm like feeling and like thinking about a stream" at the beginning of the *Salmon*, I followed up by asking, "Can you say a little more about that?" in order to clarify what she was thinking. Secondly, I gave follow-up prompts when students responded nonverbally. For example, when a student smiled I asked, "I see you smiling, what are you thinking or feeling?" Finally, I also prompted students when I saw their eyes focusing on a different page than the one I was reading. When a student is referencing something in an illustration, and I was unclear about where a student was looking, I asked, "Can you show me where you mean?" or "Can you point to where you are looking?" These are behaviors that seem to indicate that students are processing the text or illustrations and I wanted to make sure that I got as complete a picture as possible of the students' processing. Some might question whether these follow-up prompts and yellow dots on every page stimulated thinking where none was occurring at first. However, I took steps to reduce the "talking to talk" phenomenon that I experienced in previous verbal protocol work (Hilden, 2006) by allowing students to skip thinking aloud after a page was read. After three no-responses, I reminded the students that, "Remember that it is really important for you to share what you are thinking and feeling when we get to these yellow dots."

In order to guard against fatigue effects, I separated the verbal protocols and the COCA administration into two separate sessions. The verbal protocols lasted between 9

min 14 s and 21 min 42 s (excluding time taken for directions and training). On average, the verbal protocols lasted 11 min 46 s for *Dragonflies* and 14 min 26 s for *Salmon*.

In addition to each page of text, I also asked students what they were thinking and feeling once I had finished reading the book. These two cues provide an indication of how frequently students are processing the text before or after reading, and are important because processing texts before and after reading is a key characteristic of expert adult comprehension (Pressley & Afflerbach, 1995). In my previous work with verbal protocols of narrative text (Hilden, 2006), I found that second graders report very little thinking before or after reading narrative picture-books. I wondered if the same pattern would hold true for informational text that were read aloud to students.

All of the verbal protocols were audio-taped for later transcription. I also had black and white copies of the books' pages for making notes about students' visual attention and reading paths (e.g., flipping between pages) during the verbal protocols. These notes were used to add detail to the audiotaped transcripts (this kind of data has been used previously in research by Donovan & Smolkin, 2006).

Second Session. The alternative form of the COCA was administered to the students between two and five days later. The COCA administration was done by another researcher. This was done so that I would not be influenced by students' COCA results when working with their verbal protocols. The COCA is administered individually and takes approximately 10 to 15 minutes to administer depending on the child. (I scored the COCAs once I had completed my analysis of the verbal protocols.)

Materials

The COCA books, *Salmon* and *Dragonflies*, were kept in their original form

during the first session for the verbal protocols in order to maintain the comparison between the COCA and the verbal protocols. The COCA books were designed to be parallel in content and in structure. *Salmon* and *Dragonflies* share the common theme of animal groups, a topic that is somewhat familiar to most U.S. students. Both books have sections on the growth, or life cycle, of the animal. The texts were modeled closely after existing published trade books in order to maintain authenticity. However, one way that the COCA books are not like existing published trade books is that the text at the bottom of each page has been replaced with blank lines. This is done in order to remove the confounding variable of decoding from the COCA comprehension tasks. Some text still exists in the book in the form of text features (e.g., labels, headers, Table of Contents, diagrams). Another way that the COCA books are different than existing trade books is that they were designed to contain purposeful "mistakes" or places where the text and graphics have contradictory information. These "mistakes" are one way that the COCA captures the processing graphics contributor.

When conducting the COCA, the assessor reads the text for each page aloud and pauses to ask the child 19 questions across 21 (*Dragonflies*) or 25 (*Salmon*) pages. The questions were designed to tap the specific contributors of informational text comprehension discussed previously. See Table 3 for a breakdown of the number of questions per contributor for each COCA book.

Scoring the COCA involves assigning a score of 0 – 2 for each question using a scoring guide. Below is an example of a vocabulary item from page 12 of *Salmon*:

Administrator reads: *In the ocean the salmon eat shrimp and small fish. Animals that only eat other animals are called carnivores. Salmon are carnivores.*

Administrator asks: *This page tells you the definition of a word. What is that word?*

If student does not answer administrator says: *Listen closely while I reread this page.*

After rereading, the administrator asks: *This page tells you about carnivores. What does carnivore mean?*

For this vocabulary item, students receive a score of 2 if they correctly answer "carnivores" after the first time the question is asked. If students correctly identify carnivores after the text is written or responds with a correct definition of carnivores, such as "animals that only eat other animals", they receive a score of 1. Scores of 0 are given when students respond with words other than carnivores or if they fail to produce an answer after the second prompt. The individual item scores are then tallied to result in a total number for the COCA. While possible COCA scores range between 0 – 38, the actual COCA score range for second graders in the present study is 9 - 28 for *Dragonflies* and 10 – 31 for *Salmon*. A final report on the validity and reliability of the COCA is in preparation at the time of dissertation submission.

Analysis Procedures

The preliminary phase of data analysis began after I had personally transcribed the verbal protocols. In this first stage, I employed a modified grounded theory analysis to construct an inventory of processes that resulted from the verbal protocols (Strauss &

Corbin, 1990). Because the goal of the study was to compare the comprehension processes measured by the two assessment tools, I started with some pre-formed categories that correlated with the hypothesized contributors assessed by the COCA (*comprehension strategies, processing graphics, text feature knowledge,* and *vocabulary*). However, upon sifting through the data from the ground up, several categories emerged from the data that the COCA was not designed to measure. See Table 4 for the complete inventory of processes that resulted from the grounded theory analysis.

The transcripts from the protocols were scored during the second stage of analysis using the final reading processes inventory. The basic unit of coding was the turn. Each turn began when the student began speaking (or had a chance to speak but chose not to). There were occasions in which students were prompted to think aloud when I noticed them looking at a different page. A new unit was recorded when this happened. New units were not coded for prompts that resulted in a one word answer (e.g., "yes/no" or a clarifying answer), my prompt resulted in a clarification of a previous unit or if I reread a page. There were occasions in which my prompting was inadvertently leading or seemed to take the student off their original train of thinking. When this occurred, I did not count these turns as new units. (The resulting comments were not coded for processes either.)

The second stage of coding involved coding the individual processes. These codes reflected the strategies and processes inferred from students' verbalizations. When coding at the process level, I only coded a strategy once per page. For example, if a student made a connection *to prior knowledge*, then I followed up with a prompt, and then the student made a different connection, I only coded one process: *connection to prior knowledge.* Within the same page, if a student used more than one strategy, I coded for multiple

processes. For example, a student remarked about dragonflies, "That reminds me of how owls can see good in the dark. And...and now I know that they fly very fast" [*Dragonflies*]; I coded this as a *connection to prior knowledge* and *knowledge monitoring*. Coding occurred at the macrolevel. For example, I did not code among the various types of prior knowledge connections (e.g., connecting to a form of media, personal experience, or another text) in an effort to maintain the reliability of coding of the inventory. Also, while some teacher-educators have distinguished between text-to-text, text-to-self, and text-to-world connections (e.g., Keene & Zimmermann, 2000; Miller, 2002), these distinctions do not seem to result in qualitatively distinct processes. One exception to this macro-coding was the monitoring category. For this category, I noted both the macro and sub category (e.g., monitoring—text monitoring or monitoring—knowledge monitoring). I was able to reliably distinguish between these forms of monitoring. These two types of monitoring seemed qualitatively distinct from one another and focused on different sources of monitoring. Another exception occurred when coding for *intratextuality*, which occurred when students made comparisons and connections with previous pages in the book. *Intratextuality* falls under the contributor of *processing graphics* because these comments were always graphically based. However, *intratextuality* was not directly measured by the COCA. Therefore, I wanted to keep these two categories separate in the analysis. Finally, there were many comments that reflected students' ineffectual attempts at using the processes. Even though these attempts were ineffective, I still coded the processes they represented. As explained later, quality of the processes were analyzed and resulted in a quality score which fed into the

composite scores for the verbal protocols. (Additional coding directions can be found in the coding manual that is available upon request.)

I coded the data dividing the transcripts into two columns, with the verbal responses in one column, and a place for me to write in the codes in the other column. When multiple codes were present for a unit, I would underline the part of the verbal response that went with each code. As part of the iterative process of developing the inventory of processes, I kept lists of student comments that I found difficult to code for *Salmon* and *Dragonflies*. I then discussed these codes with an expert in the field of informational text in order to revise the coding scheme to account for all of the students' comments. An expert in informational text comprehension development as well as a colleague in literacy development reviewed the document which led to clarifying some codes and processes. For example, we discussed the differences between *summarizing* and *restating* extensively. From this conversation, I revised the inventory to distinguish between the final processes of *summarizing*, *restating*, and *repeating*. In order to clarify the coding process, I created a document that had examples and non-examples of the processes under question, along with explanations for the way the examples were coded. These discussions and list of examples and non-examples helped to inform the final version of the coding inventory and was used in the final coding of the data.

Revising the inventory of processes occurred until no new categories emerged from the data, redundancy between categories was eliminated, and I was satisfied that the categories in the inventory adequately depicted the reading comprehension processes captured by the protocols (Strauss & Corbin, 1990). The final inventory was again

audited by the same expert in informational text comprehension development to ensure that the processes adequately captured the verbal protocol data.

In order to compare the verbal protocols to the COCA data, I divided the categories into three separate tables. In one table, I placed processes that are the same as the contributors in the COCA (see previous discussion of the contributors assessed by the COCA). In a second table, I placed processes that fall under the COCA contributors but are not among the specific processes that were directly measured by the COCA (e.g., strategies such as questioning, were not directly measured in the COCA but do fall within the category of comprehension strategies, which is measured by the COCA). I placed processes that are truly unique to the verbal protocols (i.e., not measured by the COCA) in a third table. Each table contains a list of processes, descriptions, and examples. An expert in informational text comprehension audited the inventory for category placement within the tables. From a grounded theory perspective, the sample size was adequate in that I reached saturation, or the point where no new categories emerged before I exhausted coding the collected protocols. Saturation is met when further reviews of the data fail to result in new categories.

The third stage of coding involved assigning an overall quality score to each of the protocols. The quality score consists of two factors: accuracy of processes and quality of processes. The accuracy factor refers to how accurately students are constructing meaning for informational texts. The quality factor focuses on the overall quality of the processes reported in the verbal protocol. These factors are in turn comprised of nine subfactors. See Table 5 for the scoring rubric. For instance, one of the subfactors under quality is "active and knowledge transforming processes." Such processes go beyond

simply regurgitating what is in the text and reflect depth of thinking. Active and knowledge transforming processes occur when students internalize or elaborate upon the text. Examples of active and knowledge transforming processes include inferring (e.g., about cause-effect relationships), giving elaborative examples, comparing/contrasting information within the book or with prior knowledge. These examples are similar to processes that are believed to benefit comprehension that have been coded in previous verbal protocol work by Cote, Goldman, and Saul, (1998) and Meyers, Lytle, Palladino, Devenpeck, & Green (1990). Comments that were coded as *affective reactions* and *activating senses* also count as evidence of internalizing the text and are also examples of "active and knowledge transforming processes." Alexander (1997) has pointed out the important role that affective, emotional reactions have in reading comprehension. She posits that efferent reactions influence motivation and interest for reading, which in turn have been shown to impact reading comprehension. In contrast, in the "active and knowledge-transforming" sub-category, a student would receive a score of zero if he or she made multiple comments that were coded as *irrelevant* or *repeating statements.* The following comments come from a student who received a score of 2 on the "active and knowledge transforming processes" subcategory. Upon seeing a diagram of a dragonfly the student commented, "I think they sort of look like ants. How they have a head and a middle part, and how they have a middle part and they have a back part and legs. They look like ants." The same student continues by connecting the dragonflies' spiracles to the gills of fish, "It reminds me how fishes breathe through gills in the water, like through tiny little holes. And that's it." These and other comments suggest that this student is actively connecting the text to her prior knowledge in meaningful ways. In contrast the

following comments come from a student who received a score of zero on the "active and knowledge transforming processes" subcategory. This student's comments were often superficial. For example, when encountering the title page to dragonflies, the student comments, "I'm thinking of...that this is about dragonflies." When asked if the student could say a little more, the student simply replied, "no." Other students who received a score of one on this subcategory had comments that ranged from superficial and irrelevant to comments that showed some internalizing of the text.

Another subcategory was "genre accuracy," which fell under accuracy of processes. "Genre accuracy" refers to whether students seem to understand the informational text genre. For example, students received a score of two on "genre accuracy" when they did not make *anthropomorphizing* or *narrativizing* comments and did not refer to the book as a story. Students received a score of one when they either included one or two *narrativizing* or *anthropomorphizing* comments or referred to the book as a story. For example, the following child received a score of one for "genre accuracy" because of *anthropomorphizing* comments such as, "I'm feeling like the, I'm feeling like when they die... they're like kinda scared if they're gonna die it's like us. Like us if we're scared we're gonna die." One student received a score of zero for "genre accuracy" after she imposed a story structure onto *Salmon*. During the verbal report, this student recounted a personal story that is about a time when she and her father went fishing. Some of the student's comments were related to the pages in *Salmon*. For example, on a page that depicts salmon babies, the student says, "I'm thinking that my dad's caught a big fish and it had babies in it." On other pages, the story that the student weaves completely veered off from the text or illustrations. For example, the student

reported, "That my little brother, um, once he was in the water, and he went like this (makes a grabbing motion) and he caught a fish", on a page that discusses the fact that salmon are cold-blooded animals.

In order to arrive at a score for the quality measure for each verbal protocol, the nine subfactors under accuracy and quality each receive a score of 0-2. (The coding manual for the subfactors is available upon request.) These scores were then added together to reach a total quality score. The quality score is not based on the quantity of processes reported. Therefore, a student who only reported nine processes could hypothetically score higher than a student who reported 35 processes during his or her verbal protocol.

I concluded the analysis by establishing a composite score, or total score, for each verbal protocol. I wanted the composite score to represent what effective comprehension processing looked like for second graders reading informational texts. Therefore, the composite score for overall comprehension processing for the verbal protocols was based on three measures. The first measure represents the range in the total number of processes reported, and captures the overall activity level of processing. The second measure represents the range in the number of different processes reported. This measure represents the degree to which the reader is employing a flexible repertoire of processes when comprehending. The third measure is the total quality score, which, unlike the first two measures, is not determined by the quantity of processes reported. It is important to note that these three factors represent a set of behaviors that are thought to represent different, important characteristics of good comprehension processing (Pressley & Afflerbach, 1995).

At this point, while research has indicated that activity, flexibility, and quality of processing all matter (see Pressley & Afflerbach, 1995, for a review), it has not indicated the relative weights that these factors contribute to overall comprehension. For this reason, I decided to weigh the three factors equally. Because these three factors, total processes, different processes, and quality scores, had different ranges, I converted each of the scores into z-scores and then added the z-scores together in order to create a composite score. These verbal protocol composite scores were then correlated with the students' COCA scores.

I estimated interrater reliability at three points based on having a second rater independently code 10 of the 30 protocols. Interrater reliability was first established for units and was reached by percent agreement of total units coded. Estimated interrater reliability was 92.3% across a total of 262 coded units.

Next, I estimated interrater reliability for processes. Processes agreement was scored at the major code level and not the subcode level. For example, the following comment, "It was when I was little and there was a dragonfly sitting on my finger. I just remembered that," would be coded as *connection to prior knowledge*, not "text-to-self connection," which is one kind of connection to prior knowledge. To estimate interrater reliability for processes, I first calculated the percentage of times both raters agreed that a process was present in a verbal protocol (misses occurred when only one rater coded a process). Process presence interrater reliability reached 90.2%. Then, of those times when we agreed that a process was present, I calculated the percentage of times when we agreed on the actual process. Interrater reliability for process agreement was 88.3%. Total

interrater reliability for agreement for process labeling was 77.7% (whether the two raters correctly agreed on a process's label).

The third interrater reliability analysis focused on the total quality scores of ten verbal protocols. I had another rater independently rate 10 of the verbal protocols. For this measure, I was not interested in students' scores on individual subfactors, rather I was interested in the total quality score. In order to calculate interrater reliability for the quality scores I examined the correlations between our total quality scores. Interrater reliability, as measured by the Pearson product-moment correlation, was $r = .90$, $p < .01$.

Results

Results of this study reveal that second graders utilize a range of processes, including some highly sophisticated comprehension processes, when comprehending informational text. While the study shows considerable overlap between the COCA and the verbal protocols in the information they provide, each tool also provides unique insights as well. This study's results are organized into three major sections. First, I present the comprehension processes found in the verbal protocols. The inventory of verbal protocol processes was broken into three separate categories: processes that are directly measured by the COCA, processes that are related to the processes measured by the COCA but are not directly measured by it, and processes that are not directly or indirectly measured by the COCA. Second, I discuss the item analysis, which involved analyzing students' comments during the verbal protocols for pages where there are COCA items. Third, I compare the verbal protocol composite scores to the COCA total scores.

Inventory of Processes for Verbal Protocols

Table 6, 7, and 8 summarize the descriptive statistics for each of the 23 coded processes. These descriptive statistics are collapsed across *Salmon* and *Dragonflies*. Table 6 contains those processes that are directly measured in the COCA. Table 7 represents those processes that are related to the processes measured by the COCA. For example, while the COCA does not specifically have any *questioning* tasks, the *questioning* process falls more broadly under the comprehension strategies umbrella. Table 8 consists of those processes that are uniquely measured by the verbal protocols. Coding the 30 verbal protocols resulted in a total of 820 coded processes. The processes in the verbal protocols that are also directly measured by the COCA occurred most frequently (N = 460), and consisted of seven total processes. The processes that were related to the COCA items but were not directly related occurred less frequently (N = 177), and were also comprised of seven total processes. Finally, the verbal protocols measured nine unique processes that accounted for a total of 183 processes. Figure 1 provides a visual representation of the percentages for each of the type of process.

Table 9 describes the quantitative processing differences between *Salmon* and *Dragonflies*. On average, students reported more processes and a wider variety of processes when *Salmon* (mean of 32.44 total processes) was read to them as compared to *Dragonflies* (mean of 21.36 total processes). While the greater number of processes may be partly explained by the greater length of the *Salmon* book, it is not a sufficient explanation by itself. *Salmon* is 19% longer than *Dragonflies*, but elicits 53% more processes. Therefore, other unexplained, text-related factors may also be at work. For this reason, I will disaggregate the remaining results by form.

Also, some of the processes were only observed in one of the two texts. *Questioning the author* only occurred in the *Dragonflies*. *Anthropomorphizing, empathizing, and word identification* only occurred in *Salmon*. It is important to note that all of these processes were low in frequency (occurred five or fewer times).

Item Analysis

Another way to compare the COCA and verbal protocols is to examine how the two compare on individual items. This involves mapping out what students report when thinking aloud on pages where there are COCA items. In order to do this, I kept a record of matches, related matches, misses, and non-responses. Matches occurred when a process from a verbal protocol on that page matched the contributors measured by the COCA on that page. For example, a match would be recorded if a student reported summarizing during the verbal protocol on a page with a comprehension strategy item in the COCA. Related matches happened when students reported a process from Table 2 when thinking aloud on a page that fell under the umbrella of the contributor being tapped by the item on that page. For example, a student made a *monitoring* comment on a page where there was a comprehension strategy item in the COCA. Misses occurred when a student reported a completely different or unique process for a page than was being measured by the COCA item on that page. For example, a miss would be coded when a student's response was coded as *Processing Graphics* in the verbal protocol on a page with a comprehension strategies item in the COCA. A non-response arose when a student failed to think aloud on a page with a COCA item. The difference between non-responses versus misses is significant since the former represents a failure to respond and the latter represents a mismatch of processes. Table 10 and Table 11 summarize the item

analysis findings for the four COCA contributors. (The rates for these categories are based on the proportion of the number of items for a particular contributor multiplied by the number of students who were read *Salmon* or *Dragonflies*. For example, there were a total of 21 matches and related-matches for comprehension strategies for Salmon for four items across 16 students. I divided 21 by 56 to get .38)

The biggest mismatch between verbal protocols and COCA contributors was vocabulary. This is due in large part to the fact that there were very few processes that were coded as vocabulary in the verbal protocols. Vocabulary was only coded when the student called explicit attention to a word or verbalized that they did not know what a word meant. This only happened a total of 16 times across forms in the verbal protocols. As a result, on pages where there were COCA items, students usually reported different processes or no processes at all.

The agreement rates for *comprehension strategies* and *text feature knowledge* for *Dragonflies* are .47 and .36 respectively and represent a medium rate of agreement. The .71 rate of agreement for *processing graphics* seems particularly high. This may be due to the presence of a diagram that contrasts dragonflies to damselflies. Almost 86% of the students reported a *processing graphics* comment for this page. Similarly, 79% of students noticed that the labels did not match the illustrations on another page that depicted the environments where dragonflies live.

The agreement rates for comprehension strategies (.38) and *processing graphics* (.36) for *Salmon* represent a medium rate of agreement. The high rate of agreement, .81, for *text feature knowledge* is based on only two items, the Glossary and Index. Interestingly, while the majority of students commented on these pages, these comments

greatly ranged in their quality and accuracy. Some students demonstrated misconceptions about the purpose of these text features. One student explained that the number eight after minnows meant that, "The fishes have eight minnows." Other students clearly understood how to use these text features correctly. For example, one student commented that the index, "tells you what pages, like if you are lost and you need to find somewhere you just go to the index and it tells you where to look and what page it is." Other students simply reported that they were not sure what the index was for:

Student: "I don't know what all that is suppose to be for and everything"

(Points to numbers)

Researcher: "What do you mean? The numbers?"

Student: Yeah and the words.

If item analysis examines what the verbal protocols and COCA have in common, examining students verbal responses to the pages that did not have COCA items can be equally illuminating. Because students were asked to think aloud on all of the pages in the book that had text during the verbal protocols, one can determine whether these pages afford attention to a particular process(es). There were two pages in *Dragonflies* that did not have COCA items. Page 1 depicts a dragonfly laying eggs on a pond plant, with these various parts of the illustration labeled. While students used a variety of processes on this page, there was no particular process used consistently by the students. However, on page 8, which depicts nymphs molting for the last time, 10 of 14 students applied various *comprehension strategies*. Thus, if needed, the COCA could potentially ask a comprehension strategy question on this page. In *Salmon*, there were six pages that did not have corresponding COCA questions. Pages 1, 2, and 17 all had 50% or more of

students applying *comprehension strategies*. Interestingly, 5 of the 16 students made predictions on both page 1 and page 2, evidence that some students actively comprehend the text as soon as they begin reading. Pages 9, 11, and 18 of *Salmon* also did not have COCA questions. On each of pages 9 and 11, 5 of 16 students made restating or repeating comments. The text on these pages discusses salmon as they prepare to journey to oceans. Interestingly, these are the only pages where these processes were consistently observed in *Salmon*. Finally, on page 18, nearly half the students previewed the diagram on the following page. These students attempted to make sense of the diagram before the text for that page was even read. Overall, the additional pages seem to lend themselves to the comprehension strategies and processes that are directly measured by the COCA.

Comparing Verbal Protocol Composite Scores to COCA Total Scores

In order to calculate a bi-partial correlation between the verbal protocol composite scores and the COCA Total scores, I first created a scatterplot for each verbal protocol form. Both scatterplots revealed a linear relationship between the composite scores and the COCA scores. For the students who thought aloud to *Salmon* and took the *Dragonflies* COCA, the correlation was $r = .646$, $p < .01$. For the students who thought aloud to *Dragonflies* and took the *Salmon* COCA form, the correlation was $r = .664$, $p < .01$.

Discussion

In the following section, I will discuss the affordances and constraints that the verbal protocols and the COCA each offer when it comes to measuring informational comprehension processes. As expected, there are ways in which the two share similarities as revealed by the large correlations between the two tools. Also, the two are similar in

that there is much overlap between the COCA and the verbal protocols when it comes to measuring *comprehension strategies, text features, and processing graphics*. However, there are ways in which the two offer unique insights into comprehension processing. The COCA captures the vocabulary contributor better than the verbal protocols. There are also nine processes that were uniquely captured by the verbal protocols. I will then briefly discuss what verbal protocols tell us about second graders' informational text comprehension. Finally, I will conclude with future directions for informational text comprehension research and verbal protocol research.

Similarities between the COCA and Verbal Protocols

When discussing similarities between the two tools, it is important to point out that the correlations between the composite scores of the verbal protocols and the total scores of the COCA are large according to traditional standards (Cohen, 1988). However, these correlations are especially large given that students were read two different texts and experienced two different forms of assessments. Further, while both assessments are process-oriented, these correlations were especially surprising given that there are two different types of responses: directed questions, and thinking aloud.

The item analysis also revealed much overlap between the verbal protocols and COCA when it comes to studying three of the four contributors measured in the COCA, *comprehension strategies, text features,* and *processing graphics*. The item-analysis showed substantial agreements between the verbal protocols and the COCA for these contributors. In this way, verbal protocols provide substantive validity evidence for the COCA because many students seemed to engage in the processes hypothesized by the COCA (Messick, 1989). When reading these particular informational texts, second

graders showed evidence of using comprehension strategies, paying attention to text features, and processing the graphics when thinking aloud.

Dissimilarities between the COCA and the Verbal Protocols

Vocabulary is the one contributor in the COCA that is not as well captured by the verbal protocols. The COCA forces students to pay explicit attention to vocabulary in the texts. However, the verbal protocols simply did not elicit many comments that fell under the *vocabulary* process. This is a limitation of the verbal protocols in this study. Research has indicated that a causal link exists between vocabulary and comprehension (Blachowicz & Fisher, 2000). However, the current verbal protocols were unable to provide much insight into this process.

Another dissimilarity between the verbal protocols and the COCA are the nine processes that were revealed only in the verbal protocols. While some of these processes such as, *anthropomorphizing* and *empathizing*, occurred rarely, others occurred quite frequently (e.g., *restating, repeating, irrelevant comments,* and *narrativizing*). Future research might study how these processes relate to comprehension outcomes. For example, one might assume that students who anthropomorphize the animals and impose a narrative structure on the text might have lower comprehension outcomes. However, this is a hypothesis that needs to be confirmed by future research. Additional research might investigate how restating and repeating contribute to or inhibit reading comprehension at this stage of development.

It is interesting that three of the processes from Table 3, *anthropomorphizing*, *empathizing*, and *word study*, only occurred in the *Salmon* text. When looking back at the *anthropomorphizing* and *empathizing* comments, I noticed that all the comments are in

reference to either prey being eaten or hunted, or the salmon dying at the end of their life cycle. For example, a student said, "I'm thinking, 'ouch' that oughta hurt the salmon" (coded as *empathizing*), after reading a page about how bears and eagles are enemies of salmon. While there is a page in *Dragonflies* that references how their bodies help them keep away from animals, *Salmon* pays more explicit attention to prey-predator relationships. Also, there is no mention of the end of the dragonflies' life cycle in the *Dragonflies* text. Interestingly, this theme of dying seemed to evoke the *anthropomorphizing* and *empathizing* processes. However, it should be noted that while these processes were coded in *Salmon*, only a small percentage of students reported using these processes. Examining the text associated with the *anthropomorphizing* and *empathizing* comments suggests that subtle differences in book content can yield significant differences in comprehension processes (see further discussion below).

What Verbal Protocols Tell Us about Informational Text Reading Comprehension

One important contribution of this study is that children as young as second grade can provide informative verbal protocols. Recall that Afflerbach and Johnston (1984) posited that younger readers may produce poor read-alouds. However, the current study demonstrates that when the text is read to them, second graders are capable of reporting their comprehension processes.

Second, the verbal protocols in this study support the claim that second graders are capable of transacting with informational texts in sophisticated ways. One fascinating aspect of the verbal protocols is how frequently students would use comprehension processes together. For example, students would often combine *previewing* with *processing graphics*. Future research should investigate how young readers combine

processes, instead of studying the processes only independently. Evidence for sophisticated processing also lies in the significant overlap between the comprehension processes described in the inventory and the comprehension strategies that adult readers use (Pressley & Afflerbach, 1995). For example, 75% of second graders in this study actively constructed meaning of the *Salmon* text as soon as they began reading (within the first two pages of the book that occur before the Title page). This early processing is similar to when effective adult readers make predictions when beginning to read a new text (Pressley & Afflerbach, 1995).

While the verbal protocols can capture the sophistication of second graders' comprehension processes, this methodology is also sensitive to the range in quality of processing, as demonstrated by this study. For example, some students reported primarily "knowledge transforming," and text-related comments, while other students' verbal protocols were characterized by superficial comments and a lack of monitoring. This attention to quality seems especially important if this methodology is going to have practical applications for influencing educators' comprehension instruction.

Finally, the open-ended nature of the verbal protocol highlights some comprehension processes that are not typically captured in verbal protocol, work such as affective reactions. The verbal protocols are also somewhat unique in that they distinguish between different types of monitoring as students construct meaning from informational text.

Affective reactions. One of the types of processes revealed in the verbal protocols was *affective reactions*. Rosenblatt posited that there are two primary stances to reading (1978). The first stance, efferent reading, occurs when the reader is reading to identify

and collect information from a text. The second stance, aesthetic reading, focuses on "living through" the text and includes the reader's empathetic responses to a text. Unfortunately, this Reader Response theory (1978) is often simplified to the point where efferent reading is associated with informational texts and aesthetic reading is associated with narratives. For example, Harvey and Goudvis (2007) in their recent edition of *Strategies that work*, a reading comprehension text designed to inform teachers' instruction, wrote, "When we read efferently, we are reading to 'take away' pieces of information or to synthesize big ideas. It is the stance we take when we are reading informational text... The fiction and literature reading we do is what Rosenblatt refers to aesthetic reading" (p. 58-9). However, as this study clearly demonstrates, it is possible to combine an efferent and aesthetic stance when reading informational text. 7 out of the 30 students reported affective reactions to the text. One student even made four affective comments during his think-aloud. Alexander (1997) also explains that affective reactions to informational text can be tied to motivation for reading, which affects reading comprehension. Reacting emotionally to informational texts may not be something we frequently think about, but maybe it is something that we need to pay more attention to. For instance, more attention to how a range of affective reactions impact reading comprehension outcomes is warranted. At the very least, we need to make sure that teachers understand that affective reactions to text do not solely belong in the realm of narrative texts.

Monitoring. Another process captured clearly in the verbal protocols was the *monitoring* processes (knowledge monitoring, text monitoring, and rereading). Monitoring one's understanding of text is foundational to reading comprehension (see

Pressley & Afflerbach, 1995 for a review). The National Reading Panel Report also lists monitoring as one of seven strategies that appear "to be effective and most promising for classroom instruction" (p. 4-42, 2000). In the verbal protocols, these monitoring processes occurred frequently. All but four students reported at least one monitoring comment during their verbal protocol. The verbal protocols collected in this study reveal different kinds of monitoring at work for young children. Specifically, the verbal protocols distinguish between when students are monitoring their understanding of the text, versus when they are monitoring how the text relates to their knowledge base. This seems like a valuable distinction for both researchers and teachers. For teachers who specifically want to know more about how their students monitor their comprehension while reading, verbal protocols might serve as a valuable tool. In terms of the field of comprehension research, it would be interesting to see how these distinctions in monitoring each contribute to comprehension outcomes.

Logistics of Administration and Scoring Verbal Protocols and the COCA

When considering the affordances provided by the verbal protocols and the COCA, it is important to take into consideration the practical logistics associated with administering and scoring each of these tools. The administration time length for each of the assessments is similar, although it should be noted that there seems to be more variability associated with the verbal protocols. The COCA takes approximately 15 minutes to administer and the verbal protocols last anywhere between 9 to 21 minutes. Currently, it is beyond the scope of this study to compare how long it takes for teachers to score or code the two assessments. As a researcher who has extensive experience coding both assessments, I can attest to the fact that there seems to be a learning curve associated

with both when first learning to code the assessments. These assessments become easier and faster to score with practice. This seems to be an important consideration to communicate with teachers when they are first learning about the assessments. An important next step for verbal protocol research is to investigate how efficiently and reliably teachers can code and score the verbal protocols.

One of the major logistical costs associated with the verbal protocols over the COCA is the time it takes to transcribe the verbal protocols. Individual protocols typically took at least an hour to transcribe (with many taking over two hours to completely transcribe). Meyers and colleagues note that practitioners do not have the time or resources to transcribe tapes accurately (Meyers, Lytle, Palladino, Devenpeck, & Green, 1990). In their attempt to offer a practical solution, the researchers hand wrote all responses and questions during the verbal protocols (it should be noted that students were only responding to one sentence at a time and did not experience lengthier passages of text with illustrations, as is the case in the present study). When they compared these handwritten and audio-taped transcripts, they found that there was close agreement between these two methods (92% of content words were identical and 82.7% of total words were identical in each pair of transcripts). Furthermore, they noted that the transcriptions were consistent across the researchers. Therefore, the results of their study were based on the handwritten protocols. Because verbal protocols seem to provide additional valuable insights to reading comprehension that other assessments may not tap, studies such as this one that examine approaches that attempt to make the collection and analysis of verbal protocols more feasible are needed. Ideally, future studies could examine the reliability of teachers as they code the verbal protocols in real time.

Limitations and Future Directions

One limitation of this study is the extent to which the results can be generalized beyond the current sample of second graders. The participating students came from primarily suburban districts. Also, while the schools vary on a continuum for demographic variables, the school populations consist largely of Caucasian students. Finally, no students who receive special education services are represented in the current sample. In these ways, the sample of the current study is restricted.

There is also information that I failed to collect which would have been helpful in determining the generalizability of the current study. For example, in the future I will work to get the rate of parental consent for two of the classrooms. Next, while I have information about individuals who are English Language Learners and have Special Education designations, I did not collect other information such as individual demographic information and students' reading assessment results, that might allow me to more clearly depict who these students are. Finally, I did not collect classroom observations. Observations of factors such as teachers' informational text comprehension instruction, the amount and type of informational text available to students, and the amount of informational text writing in which students participated, would likely be helpful in determining the generalizability of this study's results. For example, it may be that some students were better able to verbalize their thinking because sharing one's thinking when reading is an established reading procedure in some of these five? classrooms. Future research could link teachers' instructional practices to the processes measured by verbal protocols.

Processing graphics. In applying the verbal protocol methodology, this study is unique because the coding system for the verbal protocols explicitly accounts for students' attempts to make sense of graphics. Interestingly, in the past, verbal protocol researchers have not paid much attention to how graphics influence meaning construction. In fact, the majority of verbal protocol studies seem to be based on texts that do not have graphics (Kucan & Beck, 1997; Pressley & Afflerbach, 1995). This presents an issue when studying how young children make sense of text as they read, because most texts for young children contain graphics. Authentic informational texts almost always contain realistic illustrations or photographs, and often include graphical devices, such as diagrams (Purcell-Gates, Duke, & Martineau, 2007). Therefore, it is perhaps not surprising that *processing graphics* was the most frequently reported process by this second grade sample. While the coding scheme accounts for occasions when students are processing graphics, it does not delineate the many ways that students are using graphics to comprehend the books. For example, using a graphic to confirm something found in the text seems qualitatively different than using the graphic to make a prediction. Additionally, I coded *processing graphics* separately from other processes in order to making the coding process simpler. However, students frequently used *processing graphics* in tandem with another process. Therefore, I highly recommend that future verbal protocol studies focus on the different ways that students process graphics and relate these graphical processes to comprehension outcomes for informational texts.

Verbal protocols and text sensitivity. In developing the COCA, *Salmon* and *Dragonflies* were designed to be as similar as possible given the differences between the two animals. For example, when designing the books, we chose two animals that

experience multiple, distinct stages in their life cycles. Also, when designing the two COCA books, we often compared the text and illustrations. For example, there are diagrams in both forms that label the parts of the animals. (In addition, the illustrator was the same in both texts, so there is a similar artistic style in *Salmon* and *Dragonflies*.) There are also several pages in both books that explicitly define vocabulary words. Finally, there are glossaries and indexes in both forms of the book.

Despite these design similarities, the verbal protocols were different in the two forms. The students who were read *Salmon* tended to report more processes and a wider range of processes on average as compared to students who were read *Dragonflies*. Therefore, the verbal protocol data suggests that there are text differences significant enough to prompt differences in comprehension processing. In other words, something about the texts elicits differences in the way students process the two COCA forms. One possible explanation for the differences may lie in the information presented in the books. As discussed previously in the verbal protocols, students made *affective* and *empathizing* comments on the pages in *Salmon* that discuss prey relationships and the death of the Salmon at the end of their life cycles. Similar information is not presented in *Dragonflies*. Also, it may be possible that students have more experience or prior knowledge with fish than insects. Such differences in prior knowledge may partly explain the processing differences in the two forms.

An important question arises, how much of these differences are due to the text sensitivity of the verbal protocols? In other words, what does any one verbal protocol tell us about a student's comprehension processing of another similar text? Myers, Lytle, Palladino, Devenpeck, and Green (1990) asked a similar question about the stability of

processes across verbal protocols of narratives for fourth and fifth-graders. They found that five of the six categories of "moves" (similar to what I call processes) had intraclass correlations of .72 or above. They concluded that moves were stable across the three stories, especially when the moves occurred with some frequency. Similar verbal protocol work could be done with informational texts and younger readers.

Of course we know that the way we comprehend is dependent on a variety of text factors (see RAND Reading Study Group for a review, 2002). However, if verbal protocols are to be helpful to teachers, there needs to be some generalizability across texts. Future research could study the stability of processing across multiple texts for developing readers. Establishing processing stability seems an important next step if verbal protocols are to be used as a practical assessment tool for teachers in the future.

Sensitivity to instruction. Research that would establish whether these assessments are sensitive to instruction would strengthen their validity and also serve to increase their usability to teachers. Currently, work is underway to investigate the impact of first and second grad teachers' administration and use of the COCA over a school year (Bolt, Duke, & Billman, 2008). However, similar work has not been conducted with verbal protocols. While researchers have used think-alouds as a method to improve students' comprehension (see Kucan & Beck, 1997 for a review), researchers have not typically looked at whether verbal protocols are sensitive to instruction (see Brown, Pressley, Van Meter, & Schuder for an exception). For example, if teachers gradually release a strategy to students over the course of several weeks, do students report this strategy more frequently, and with a higher quality, when thinking aloud? As an anecdote from the present study, while collecting verbal protocols in one classroom, I noticed that most of

the students were asking multiple questions when thinking aloud in the form of "I wonder" statements. Afterwards, I asked the teacher if they were currently working on the questioning strategy. She informed me that the class had just finished studying questioning as a part of her reading comprehension instruction and that she used the "I wonder" language as a way to introduce the strategy. Linking verbal protocols to instruction represents a promising direction for verbal protocol research, and is an important step to establishing verbal protocols as a useful assessment tool for teachers.

Verbal protocols and comprehension outcomes. These last two future directions are a part of a larger need for verbal protocol research. A crucial next step for verbal protocol research lies in tying the results of verbal protocols to comprehension outcomes. Pressley and Afflerbach made a similar observation in 1995. Unfortunately, very few researchers have taken this next step. My previous work with narrative texts (2006) is an exception. However, I found no significant correlations between students' strategy use and retellings as measured by propositions recalled from the stories. Meyers and colleagues (1990) also took this step, finding both positive and negative correlations between categories of comprehension processes as measured by think-alouds and passage comprehension. Part of the problem in establishing correlations between verbal protocols and outcomes is methodological in nature. The vast majority of verbal protocol work is done with very small sample sizes, which makes it difficult to find statistically significant correlations. For example, in Pressley and Afflerbach's review of verbal protocols in reading, only 6 of 38 studies had 30 or more participants.

Also, part of the problem of linking individual processes to comprehension outcomes might lay in the fact that much of past verbal protocols research has not

attended to the quality of processes reported. Whether or not a student applies a particular process may not be as important as the quality of that process. For example, Williams (1993) found that the comprehension processes of students with learning disabilities tended to be more tangentially related to the text than the processing of average achieving students. Both the students with learning disabilities and the average achieving students were using similar strategies. However, the average achieving students were more effective at applying them. Most students in the primary grades are novices at applying these strategies, and are not likely to apply them all equally successfully at once. In other words, they do not resemble many of the effective adult readers that comprised Pressley and Afflerbach's model of "constructively responsive reading" (1995). Perhaps this is not surprising, given that Pressley and colleagues noted that such self-regulated strategy use takes years to master in school (1992). Thus, what processes seem to hinder or aid comprehension outcomes at this stage of development is difficult to answer when issues of quality seems so crucial. Therefore, a strength of the current study is that I have shown that quality of processing can be articulated on a continuum and can be reliably scored. Future research could examine the relationship between quality scores and outcomes.

Reading comprehension development is a complex web affected by multiple related factors. Only through concerted research efforts which use multiple methodologies and measures can we continue to untangle it.

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MANUSCRIPT 2: PROFILES FOR INFORMATIONAL TEXT COMPREHENSION IN SECOND GRADE

Reading comprehension has been defined as the "process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (RAND Reading Study Group, 2002, p. 11). Furthermore, this process is influenced by three factors: the reader, the text, and the activity in which the reading is occurring (RAND Reading Study Group, 2002). The abilities and dispositions that an individual brings to reading, such as one's background knowledge, motivation, cognitive capacities (e.g., memory, fluency, oral language) all influence how a reader comprehends. Text features such as the semantic and syntactic difficulty, length, and topic can also influence reading comprehension. Additionally, the genre of the text also affects how we comprehend (Kucan & Beck, 1997; Pressley & Afflerbach, 1995). Finally, the activity, or purpose for which reading is done and the consequences attached to it also impact reading comprehension (RAND Reading Study Group, 2002). However, these three factors do not act independently but rather influence one another. And it is how these factors uniquely weave together that makes reading comprehension so fascinating and complicated to study.

Verbal protocol methodology has greatly informed what is known about how expert adult readers construct meaning from texts. Researchers who use verbal protocols are typically interested in finding out what is going on in the mind as a person completes a task. Verbal protocols have a long history in the field of cognitive problem-solving (Ericcson & Simon, 1984). Since the 80s, researchers have applied this methodology to the field of reading to learn more about the cognitive processes involved in reading

comprehension. From Pressley and Afflerbach's (1995) seminal work that synthesized verbal protocol research, we now know that expert readers are constructively responsive when they read. This means that they apply a repertoire of comprehension strategies before, during, and after reading. And that they flexibly apply this repertoire based on various text factors and their purposes for reading. Furthermore, from these verbal protocol studies we know that effective comprehenders monitor their on-going comprehension and have fix-up strategies for when their comprehension breaks down.

While we have a clear vision of the processes involved in expert reading comprehension in adults, the vision for how reading comprehension develops in young readers is much less clear. Cain and Oakhill (2007) reviewed studies that examined how individual factors such as phonological, metalinguistic, semantic, and syntactic skills impact children's reading comprehension. They concluded that there are not definitive trajectories for reading comprehension development and that we need better models of development.

Verbal Protocol Methodology and Comprehension of Developing Readers

One area of reading comprehension development that has not received extensive attention is the study of the online comprehension processes used by younger readers. Verbal protocols represent a potentially fruitful methodology for studying these online processes. However, this methodology has not been as extensively used with young readers, particularly children in second grade and below. This lack of protocol studies with developing readers is likely due in part to the assumption that they are incapable of providing useful verbal protocol data. Afflerbach and Johnston (1984) reasoned that verbalizing their thoughts is likely to overwhelm the developing readers' cognitive

resources, and therefore, the methodology would not result in an accurate description of their reading comprehension processes. Furthermore, Afflerbach and Johnston reasoned that young readers may not be sufficiently metacognitively aware to accurately report their thinking.

Despite these reservations, Afflerbach (2000) called for future verbal protocol research to study the developmental nature of reading comprehension. Presumably this would include primary grade children. While the reasons discussed above discourage employing verbal protocol methodology with young students, positive research evidence exists for the potential use of this methodology. One study found that second graders were capable of verbalizing their thinking as they read an illustrated Aesop's fable (Brown, Pressley, Van Meter, & Schuder, 1996). These researchers triangulated the verbal protocol with other assessment data.

In my past verbal protocol research (2006), I found that second graders who read at or above grade level could verbally report their thoughts and feelings while reading a narrative picture book aloud. Similarly, Alvermann concluded that the second graders' in her study, "seemed relatively at ease with the task" of thinking aloud (p. 186, 1984). In this verbal protocol study Alvermann analyzed second graders' verbal protocols to investigate strategies that students used to comprehend narratives in basal readers.

In contrast, the present study is unique because it focuses on the comprehension processes that students apply to informational texts. Currently, researchers have not used verbal protocol methodology to focus on how primary grade students construct meaning from informational texts. The issue of genre is an important one as research suggests that genre impacts the way we process as we read, both for adults (Kucan & Beck, 1997;

Pressley & Afflerbach, 1995) and children (e.g., Duke, Pressley, & Hilden, 2004; Hidi & Hildyard, 1983; Langer, 1996).

Reading Profiles

Few researchers have used verbal protocols to develop profiles of reading comprehension. Wade (1990) developed a taxonomy of five profiles of narrative reading comprehension using verbal protocol methodology. Wade had struggling second to ninth grade readers think aloud they read short segments of stories. These profiles focused on cognitive top-down and bottom-processing and focus primarily on students' connections to prior knowledge and ability to monitor their comprehension. The five profiles included: *good comprehenders, the non-risk taker, the non-integrator, the schema imposer, and the storyteller*. Wade characterized *Good Comprehenders* as interactive readers who monitor their comprehension. In contrast, the *Non-risk Takers* assumed passive roles because they did not go beyond the text. Wade concludes that these readers "either lack or underutilize their background knowledge and over rely on the text to suggest an appropriate schema (p. 447). The *Non-Integrators* did not connect the hypotheses they made to one another or the text. The *Schema-Imposer* is a top-down processor who applies a schema early on and holds onto it despite incoming conflicting information. Finally, the *Storyteller* allows their prior knowledge to take over the information in the text to the point where their comprehension does not resemble the original text. The present study uses a wider lens when looking at comprehension in that I did not limit my investigation to only cognitive strategies, but included other processes linked to comprehension.

Wade, Trathen, and Schraw (1990) used cluster analysis to create an empirical taxonomy of college students as they studied a lengthy expository text. This taxonomy consisted of six clusters, or profiles, of students: *Good Strategy User*, the *Information Organizer*, the *Flexible Reader*, the *Text Noter*, the *Mental Integrator*, and the *Memorizer*. These profiles were organized around the three types of strategies or tactics that they applied when reading: text-noting tactics (e.g., highlighting, underlining, outlining, diagramming), mental-learning tactics (e.g., mental integration, connecting to background knowledge, imaging, and self-questioning), and reading tactics (e.g., varying reading speed and re-reading). The *Good Strategy Users* used the widest range of study tactics and were more likely to provide the purposes for using each tactic. The *Information Organizers* also reported many mental learning and text-noting tactics, but rarely reported reading tactics. Their comprehension tended to focus on organizing the main ideas. *Flexible Readers* placed heavy emphasis on reading tactics. They frequently reported changing their reading speed and re-reading flexibly according to their changes in understanding of the expository text. The *Text Noters* almost exclusively used text-noting processes. The *Mental Integrators* relied heavily on the mental-learning tactics and only reported a few of the other types of tactics.

Purpose of the Study

Recently when I collected verbal protocols, or think-alouds, from second graders as they processed an informational text, I noticed how differently the students went about constructing meaning. The fact that students uniquely transacted with the texts should not be surprising. Indeed, as stated previously we have come to expect that individuals uniquely transact with the text as they read, as this is one of the tenets of modern

comprehension theory (Pressley & Afflerbach, 1995; Rosenblatt, 1978). However, what is not well known are the different ways that second graders construct meaning when informational texts are read to them. Therefore, in the current study I sought to address the following research question: What are different profiles of informational reading comprehension in second grade? Answering this question has potentially noteworthy implications for developmental reading comprehension theory and instruction. Better understanding of the profiles of active meaning making in developing readers will help the field identify different patterns and levels of sophistication in development. Additionally, future research could link these processing profiles to comprehension outcomes. Also, the ability to pinpoint students' strengths and weaknesses in comprehension processes would likely enable teachers to streamline their comprehension instruction. If future research could link profiles with comprehension outcomes, then additional research could investigate how these profiles could be used to inform teachers' reading comprehension instruction.

Methods

In this study, I investigated different profiles of informational reading comprehension in second grade. I used grounded theory analysis (Strauss & Corbin, 1990) to develop an inventory of reading comprehension processes that the second graders used when processing an informational text. The second step consisted of identifying processing patterns students used when constructing meaning from the text. From these emerging patterns, I created profiles that classified the protocols.

Participants

This study involved 30 second grade students from five classrooms. Within each classroom, I divided the consenting students into six ascending ability groups. These rankings were based on teachers' perceptions of students' informational reading comprehension. I then randomly sampled one student from each group. This random sampling resulted in 19 girls and 11 boys who participated in the study. Three of the students were English Language Learners and none of them received special education services in the 2006-07 school year. See Tables 1 and 2 for student and school demographics.

Data Collection Procedures

This study was a part of a larger study that compared second graders' verbal protocols to their scores on the Concept of Comprehension Assessment (COCA), a newly developed process-oriented reading comprehension assessment for informational text (Billman, Duke, Hilden, et. al, 2008). In the COCA, students answer questions or fill in blanks as an informational text is read to them. These questions and blanks were purposefully designed to assess four hypothesized contributors to informational reading comprehension: *comprehension strategies, processing graphics, text feature knowledge,* and *vocabulary*. The COCA authors chose four strategies to represent the larger range of comprehension strategies that effective comprehenders apply when reading. These strategies included: previewing and predicting, connecting to prior knowledge, inferring, and summarizing. Items that assess p*rocessing graphics* measure students' understanding of illustrations and graphics such as, diagrams, tables, maps, and illustrations. *Text feature knowledge* refers to the ability to recognize and apply common text features to informational texts (e.g., Table of Contents, index, labels, captions, and pronunciation

guides). Finally, the *vocabulary* contributor consists of two related items. The first type of *vocabulary* item examines students' knowledge of high-utility words that cut across many domains. The second type of *vocabulary* item measures students' ability to infer word meaning from the surrounding text and graphics.

In the larger study, students participated in two individual sessions spaced one to three school days apart. In the first session, the students were trained in the verbal protocol procedure and produced a verbal protocol to one of the two forms of the COCA, *Salmon* and *Dragonflies* (these books are described in greater detail later). During the second session, a research assistant administered the other form of the COCA. For the purposes of this study, only the first session is of interest.

The first session began by asking students to think-aloud while solving a 3-D puzzle. This served as an introduction to thinking aloud. Before assembling the puzzle, students were asked to verbalize whatever they were thinking or feeling while putting it together. Students were cued approximately once a minute if they did not independently verbalize what they were thinking or feeling. (See Appendix A for the Think-Aloud Protocol.) After completing the training activity, the students were given the following directions for thinking aloud with the book:

> Now before we start, I have some directions. What I am really interested in is hearing your thoughts and feelings about the book as I read it to you. So just like the puzzle where you told me what you were thinking and feeling, I want to know what's going on inside your mind as you read. You can stop and tell me what you are thinking whenever you want. That is okay. Remember, just like the puzzle, there are no right or wrong

answers. Also, do you see these yellow dots? I will stop and ask you to tell me what you are thinking and feeling when I get to each yellow dot. Sometimes there may be places where the book is not making you think or feel anything. If this happens you can shake your head no or tell me that you are not thinking anything and we will go on. Also, it is okay if you want to flip through and look at pages. Finally, if you want to hear any of the pages again just ask and I will reread the page to you. Can you tell me the directions so that I know you understand please? (Clarify any misconceptions and review directions as needed.)

I checked to make sure that the students included three main points when repeating the directions: 1) the student can think aloud at any time 2) the student should either think aloud after yellow dot or say, "I'm not thinking anything" 3) the student can ask to reread.

After establishing the directions for thinking aloud, I read either *Salmon* or *Dragonflies* to the students. Book selection was randomly assigned within each class with roughly equal numbers of students experiencing each form. Students were cued to think aloud on each page. A nonverbal reminder to think-aloud was present on each page in the form of a yellow dot in the bottom outside corner (this "dot" method has been employed in past verbal protocol work, e.g., Olshavsky, 1976-7). Reminders to think aloud were also given on each page when students did not verbalize independently. This verbal cue took the form of "What are you thinking or feeling?" or directed them to "Think aloud for me." Nondirective prompts such as these have been used successfully in the past and is believed to minimize the influence that the researcher has on the participants' verbal

reports (e.g., Bereiter & Bird, 1985; Lundeberg, 1987; Myers, Lytle, Palladino, Devenpeck, & Green; 1990; Olshavsky, 1976-7; Wyatt, Pressley, El-Dinary, & Stein, 1993). A frequent criticism of verbal protocols is that they are thought to stimulate thinking that would not otherwise occur in the absence of verbalization (Nisbett & Wilson, 1977; Scardamalia & Bereiter, 1983). In light of this criticism, I attempted to reduce the "talking to talk" phenomenon that I experienced in previous verbal protocol work (Hilden, 2006) by allowing students to skip thinking aloud after a page was read. If students failed to think-aloud on three pages I reminded them that, "it is really important for you to share what you are thinking and feeling when we get to these yellow dots."

Follow-up prompts were given in several situations. First, follow-up prompts were given in order to clarify what a student was trying to communicate. For example, when a student commented that, "I already knowed that" in *Salmon*, I followed up by asking, "You already knew what?" in order to clarify what she was thinking. Secondly, I followed up when students responded nonverbally. For example, I asked, "I saw you kind of frown on that page while I was reading. What made you do that do you think?" Finally, when students focused their attention on a different page than the one I was reading I would use a follow-up prompt, "I saw you looking at this other page (p. 17) when I was reading this page (p. 16). Can you tell me what you were thinking when you looked over there? (p. 17)" Similarly, when I was unclear as to what a student was referencing in an illustration, I would ask, "Can you show me where you mean?" or "Can you point to where you are looking?" These non-verbal behaviors seem to indicate that the student is processing the text or illustration. I wanted to make sure that I got as complete a picture as possible of the students' processing.

In addition to the yellow dots on each page, I also asked students to think aloud once I had finished reading the book to them. Continuing to process a text after reading is a characteristic of expert adult readers (Pressley & Afflerbach, 1995). I wanted to see whether second graders would also think aloud once the reading was complete. In my past verbal protocol work (Hilden 2006) I found that second graders only infrequently thought aloud once they had finished reading.

The verbal protocols lasted between 9 min 14 s and 21 min 42 s (excluding time taken for directions and training). On average the verbal protocols lasted 11 min 46 s for *Dragonflies* and 14 min 26 s for *Salmon*. (The greater length of protocols may be partly explained by the greater number of pages in the *Salmon* book. *Salmon* is 19% longer than *Dragonflies* in text length, and results in 23% longer verbal protocols.)

The verbal protocols were audio-taped for later transcription. I also took notes regarding students' visual attention and reading paths (e.g., flipping between pages) on black and white photocopies of the books during the verbal protocol collection. I then used these notes to add details to the transcripts as I transcribed from the digital recordings. (Donovan & Smolkin have used a similar data source in previous work; 2006.)

Materials

Students were read either *Dragonflies* or *Salmon*. These two texts were designed so that they have parallel content and structure. They are both about animals that are likely to be somewhat familiar to most U.S. students. They both have sections on the life cycle of the focus animal. These informational texts were closely modeled after published trade books in order to maintain their authenticity. However, the books were originally

designed for the COCA assessment. As such, these books are not like existing trade books in a few ways. First, the text at the bottom of each page has been replaced with blank lines. However, some text still exists in the book in the form of text features (e.g., labels, headers, diagrams, and the index). When introducing the book, I ask students if they notice anything different about the book compared to others they have read, as a way to point out that the text has been replaced by lines. Second, some of the pages have places where the graphics are arranged in such a way as to be at odds with the text. For example, in *Dragonflies*, there is a page where there are three illustrations that depict environments of dragonflies: forests, deserts, and mountains. The corresponding labels are mixed up. In the COCA, the students are asked if they notice a mistake on these pages. Prior to starting the verbal protocols, I cue the students that there might be mistakes in the book, "in this book there may be a few pages where the authors or illustrator made mistakes. For example, the picture may not match what the words say on the page. If you see a mistake, be sure to let me know."

Analysis Procedures

I began data analysis by analyzing the verbal protocols using a modified grounded theory analysis (Strauss & Corbin, 1990). This resulted in an inventory of processes that the second graders in this sample used to construct meaning from the informational texts. I began with some pre-formed categories from the COCA assessment (Billman, Duke, Hilden, et. al, 2008). These pre-formed categories included: *comprehension strategies* (predicting, summarizing, connecting to background knowledge, and inferring), *vocabulary knowledge and strategies, text feature knowledge,* and *processing graphics*. Also, when I came across processes that I had trouble labeling, I consulted reading

comprehension research that had labeled similar processes in the past. For example, I noticed a subtle difference between when students asked questions about the content in the book versus when they asked questions about the way the author or illustrator crafted the text or illustration. Influenced by the instructional comprehension strategy, *questioning the author* (Beck, McKeown, Sandora, Kucan, & Worthy, 1996), I decided to distinguish between these processes. When consulting the reading comprehension research did not help with labeling processes, I came up with descriptive labels on my own (e.g., *narrativizing*, and *anthropomorphizing*).

Revising the inventory of processes was a recursive procedure that continued until no new categories emerged from the data, category redundancy had been eliminated, and I was satisfied that the inventory successfully captured the reading comprehension processes in the verbal protocols (Strauss & Corbin, 1990). Once I was satisfied with the inventory I had an expert in the field audit it to ensure that the inventory adequately represented the verbal protocol data. Several small changes in the description of the individual processes resulted from the audit. The final inventory consists of 23 processes. The inventory of processes includes a description and examples of each of the 23 processes. This inventory can be found in Table 4.

Next, I applied the coding processes to each verbal protocol. These codes reflected the processes inferred from students' verbalizations. When coding processes, I only coded a process once per page. Therefore, if a student asked multiple questions on one page, I only coded one questioning process. This did not preclude multiple processes for one page. For instance, I coded the following exchange as both *inferring* and *intratextuality*.

Student: The eagles and bears like to eat salmon just like the other page. It said that salmon are smaller than bears and bears are bigger so the bears will eat the salmon.

Researcher: You said, "just like the other page." What other page were you talking about? Can you show me?

S: Sure. (Flips to page 10). See on this page that animal is bigger than that, and that, and that [points to minnows]. And those animals are smaller. And if it is smaller, if the animal is bigger it will eat it. And the bear is bigger than the salmon.

Coding occurred at the macrolevel. For example, when a student interpreted the index, I coded the comment as *text feature knowledge,* not index. One exception to this macro-coding was *monitoring*. I broke this process down into three subprocesses (monitoring—text monitoring, monitoring—knowledge monitoring, and monitoring—rereading). Another exception was when I coded for *intratextuality*. This process happened when students connected pages in the book. *Intratextuality* falls under the larger process of *processing graphics*. However, *intratextuality* is not directly measured by the COCA, so I kept the two processes separate in the analysis. Finally, there were many occasions when students ineffectively attempted to use a process. I still coded these as the processes the student was attempting. (The complete coding manual is available upon request).

Interrater reliability was estimated on ten protocols that were randomly selected. To calculate IRR for the processes, I first calculated the percentage of processes that we

agreed were present (misses occurred when only one rater coded a process). This form of interrater reliability reached 90.2%. Then, of those times when we agreed that a process was present, I calculated the percentage of times when we agreed on the label for the process. Interrater reliability for labeling the processes was 88.3. Total interrater reliability for agreement for process labeling was 77.7% (whether the two raters correctly agreed on a process's label).

Once I had created an inventory of processes and coded the verbal protocols, I designed a rubric for the profiles and then assigned verbal protocols to these categories. When coding the verbal protocols, I quickly noticed that students seemed to be going about creating meaning from text differently. Some students seemed very active and resembled the "constructively responsive readers" that Pressley and Afflerbach describe (1995). Others seemed to talk a lot, but there was not much substance to their comments. In contrast, other students seemed to not have much to say at all. As I coded the protocols, I kept notes on my reactions to what made each of these readers stand out. Once the coding was complete, I reviewed my notes and developed categories based on the number of processes used, the range of processes used, and the nature of processes used. I revised the categories until the profiles were mutually exclusive (that a student's verbal protocol did not meet the criteria for more than one profile) and saturation was reached (all of the readers/verbal protocols were accounted for by the profiles).

The finalized rubric consists of six distinct profiles: *Active Processors, Active Processors with Foundation Process(es), Single Processors, Active and Superficial Processors, Single Superficial Processors,* and *Passive Processors.* In order to reach a single process threshold or superficial processor threshold (seven total irrelevant or

repeating comments), a student must report a process seven times. Seven processes seem to be an appropriate number for these profiles, which represents between quarter and a third of the cued speaking opportunities (with this equaling the number of pages plus the post cue). It makes sense then, that using a process seven or more times would significantly affect the meaning construction of that book. Similarly, seven seems to be the appropriate number for establishing the number of different strategies required for the *Active Processors* profile as it represents roughly a third of the 23 total strategies in the inventory. The number of total processes needed to reach the *Active Processor* profile is simply the number of pages in the book plus one (opportunity to make a comment once the book was finished). It seems reasonable that actively processing students should average at least one process per page. This profile does not require a student to speak on every page, rather students should average at least one process per page.

Once I was satisfied that these profiles adequately captured the different profiles in my data, I had an expert in informational reading comprehension audit the rubric to ensure that the profiles captured the data and were mutually exclusive. See Table 12 for descriptions and criteria for the six profiles.

Results

This study demonstrates that second graders are capable of verbalizing their thinking and feelings when being read an informational text. Their comprehension processes ranged from the highly sophisticated to the superficial, with distinct patterns or profiles of reading processing for different readers. The following section is dedicated to further describing these different informational reading profiles. Table 13 consists of a

frequency count and descriptive statistics for the profiles. In order to better capture the profiles, I will also provide an example of a student who fit each profile.

Active Processors

The students who qualified for this profile (along with the *Active Processors with Foundation Process(es)*) were the most active as measured by the total number of processes. However, they did not rely heavily on any one process, rather they flexibly used a wide variety of processes. This active and flexible application of processes is a hallmark of effective readers in adult verbal protocol literature (see Pressley & Afflerbach, 1995 for a summary). Additionally, while not a specified criteria for the profile, all of the active processors except for one also connected to their background knowledge.

Ben[1] was an *Active Processor* who was read *Dragonflies*. I chose to discuss Ben's verbal protocol because he represents a typical *Active Processor*. Ben's verbal protocol resulted in 29 total processes, of which twelve were different. Ben's first comment is on the first page where she makes a prediction, "Um, I'm feeling like the story is giving an idea about like a life cycle or something like a dragonfly." He goes on to apply other comprehension strategies as well as report affective reactions, "I'm feeling that like, kinda good because I'm learning more about them [dragonflies]" (double-coded as *knowledge monitoring* and *affective reaction*). When I asked him what made him say that on that particular page, he went onto summarize what he had learned thus far in the book. A defining characteristic of *Active Processors* is that they frequently will apply more than one strategy per page and that these processes will be used in tandem together.

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[1] All of the students' names have been changed to protect the participants' privacy.

Another example of this is when the student looked at a diagram of a damselfly and made the following comment:

> I sorta knew it because in class we studied insects and I knew it because different parts of the body. And so this is their head and this is their thorax and this is their abdomen [student points to different parts of the body as she reads the labels], so different parts of their body.

This comment was double coded as *prior knowledge* and *text feature knowledge* because he read the labels associated with different parts of the dragonfly's body.

Active Processors with a Foundation Process(es)

These students met all of the same criteria as the *Active Processors*. However, these students were different in that they relied heavily on at least one process. Eight of the eleven students relied heavily on a single process. These processes included, *processing graphics, restating, monitoring, prior knowledge, inferring, and questioning.* The remaining three students relied heavily on two processes, *processing graphics* and either *restating*, *monitoring*, or *questioning*. By far the most common foundation process was *processing graphics*. Of the 11 students who qualified for this profile, six reported using *processing graphics* a minimum of seven times. This is perhaps not surprising given that *processing graphics* was the most commonly reported strategy, with 156 occurrences. To give a frame of reference, the next most reported process was *prediction* with 82 occurrences. This just highlights how crucial illustrations were to how students constructed meaning from the text.

Anna was an *Active Processor with Foundation Process(es)* who was read *Salmon*. She reported 39 processes, of which 12 were different. She relied heavily

on questioning, which accounted for 14 of the total processes. Often these questions took the form of "I wonder" statements. Again, Anna was typical of her profile. Similar to the *Active Processors*, Anna's reports on a single page frequently reflected more than one process. For example, on a page that has a diagram depicting the life cycle of *Salmon*, Anna commented:

> I wonder why they die and why...and why they, and I wonder why they die. And um...and.. and I um. There is going to be a pattern because they are eggs, and then they will hatch and have the yolk, then they turn into babies and then they are like almost like an adult, and then they are an adult and they turn red and then at the top [refers to picture at 12 o'clock, during the entire comment she follows the pictures with her finger in a clockwise position].

On this page Anna starts by self-questioning. Then after a pause during which she collects her thoughts she makes a prediction that there will be a pattern to the life cycle. Anna confirms her prediction on the next page.

> Researcher: You're smiling. Why are you smiling?
>
> Student: Because I said there was like going to pattern that it was going to start again and that's it!

This was rare, as students did not often confirm predictions or answer their questions. Similar to the *Active Processors*, Anna monitors her comprehension and growing knowledge of salmon. Towards the end of the book she comments, "I never knew. I only thought there was one type of salmon. I didn't know there were all of these types."

Single Processors

Unlike *Active Processors*, *Single Processors* are not as active or flexible in how they construct meaning from text. Typically these students report fewer total processes and a more restricted range of different processes. On average, *Active Processors* and *Active Processors with Foundation Process(es)* reported 30.7 and 36.5 processes and used 11.7 and 11.8 and different processes respectively. In comparison, *Single Processors* on average reported 22.2 processes and used just 8.0 different processes. Another rough estimate of activity is the number of pages on which students did not make any comments. The *Active Processors* and the *Active Processors with Foundation Process(es)* on average only skipped 3.09 pages. In contrast, the *Single Processors* skipped over twice as many pages, 7.6 pages on average. Like the *Active Processors with Foundation Process(es)*, the verbal protocols of *Single Processors* are dominated by a single process. These single processes included, depending on the reader, *predicting, questioning*, and *connecting to prior knowledge*. Interestingly, these processes are all comprehension strategies and are frequently emphasized in teachers' reading comprehension instruction (e.g., see teacher guides such as Keene & Zimmermann, 1997; Miller, 2002). These processes seem to play an even more important role for the *Single Processors* than the *Active Processors* because the meaning construction is largely based on a single process.

I read *Dragonflies* to Nadia, a *Single Processor*. Of the 18 pages on which Nadia commented, she made predictions on seven of them. She made a range of predictions. For example, she used the Table of Contents to predict what the book will be about, "I think this is going to be a lot of different stuff like stages of a dragonfly [reading heading] and

there are going to be a place where it is going to be about the eggs [reading heading]." She also seemed to understand the informational genre when she predicted that, "I'm thinking that it's going to um, tell more facts about the nymphs and um, that's all Interestingly, Nadia did not confirm or revisit her predictions. It is important to note that while Nadia largely relied on prediction, she used a few other processes such as *summarizing, processing graphics, inferring*, and demonstrating *text feature knowledge.*

Active and Superficial Processors

The *Active Processors and Superficial Processors* profile sounds like an oxymoron but is a real profile found for one child in this study. These students meet all of the criteria for the *Active Processors* profile. They have a high rate of activity and also demonstrate a wide range of processes. They also show some evidence of monitoring their comprehension, as effective comprehenders do. However, their high activity rate is due in part to numerous irrelevant and/or repeating comments. While only one student in this sample met this profile, I am suspect that this is a profile that many teachers could identify with. These are students who have a lot to say about what they are reading, but not all of it is likely to improve their comprehension in the long term. These students are learning how to be active thinkers when reading, but they have not yet learned how to do it selectively in a way that will benefit their comprehension.

Jude was an *Active and Superficial Processor* who was read *Salmon*. While Jude qualified for the Active Processor profile by making a total of 27 processes and using 12 different processes, he also made eight irrelevant comments. For example, after reading a page packed with information about alevins, baby salmon, the student simply replied, "I think they are cute." Similarly, after reading about how salmon are full grown when they

are about three years old, Jude looked at me and said, "Wet fishies." This is not to say that Jude was incapable of deeper thinking. For example, when reading about how young salmon eat zooplankton Jude made the following connection, "I know. On *Sponge Bob Square Pants* they are called plankton. That's what these are [points to zooplankton label]." Some of the comments that were not coded as irrelevant also seemed superficial in nature. For example, after Jude identified a graphic that labeled the parts of a salmon as a diagram I used a follow-up prompt to which Jude replied, "Just diagrams." While this statement was coded as *processing graphics*, it seems more superficial compared to other students who interpreted the diagram by discussing the parts of a salmon and made *connections to their prior knowledge* on this page.

Single Superficial Processors

Single Superficial Processors are those who meet the criteria for single processor but also have a high rate of irrelevant comments and/or simply repeat the text. This profile is dominated by a single process and superficial comments.

Cindy met the criteria for the *Single Superficial Processor* profile and was read *Salmon*. Of the 26 total processes coded, only five different processes were represented. She made an overwhelming 11 *narrativizing* comments and 8 *irrelevant* comments. (It is important to note that other single processes are theoretically possible.) Combined these represent 73% of her reported processes. Cindy is an English Language Learner, however her protocol was one of the longest. Her tie to the text was tenuous at best. In order to construct meaning to the text, she told a parallel story about going fishing with her family. For example, towards the beginning of the book the authors discuss how salmon hunt for minnows when they are about one year old. Cindy's response was:

Student: Um, my dad caught one of these before but except it was caught on a tree.

Researcher: It was what?

Student: My brother caught one of that. And then after he said it's not, it's not good. Because once we buyed one from the store, one like that from the store and it wasn't good. So when we went fishing and my brother caught one of it and he said it was not good so we threw it back in the water.

Some of her responses were tied to the illustrations. For example, there is a picture that depicts a salmon on its back as it makes a gravel nest for eggs. Cindy commented that, "The fish that my brother got, the people threw it, and the other people came, um, they fished it and then they took it home and then they ate it and it's not good." Several other students also commented that it looked like the illustration showed a fish that had been thrown into the water. However, they did not incorporate this observation into an ongoing story. Overall, Cindy's comments were very picture-based and largely ignored the written text.

Passive Processors

Passive Processors are those students who show a low rate of activity as measured by the total number of processes reported. On average, *Passive Processors* reported just 18.1 processes for 21 (*Dragonflies*) to 25 (*Salmon*) pages of text. While their range in processes used is narrower than the *Active Processors* profile, they are still demonstrating that they have numerous different processes in their repertoire, 8.4 different processes on average. Of the nine students who met the criteria for this profile,

only three students reported fewer than eight different processes. This demonstrates that these students can engage in a range of different processes, they just rarely do so. Additionally, all but one student made at least one *monitoring* comment. Similar to the *Single Processors*, these students were more likely to skip thinking aloud to pages than their *Active Processor*s. On average the *Passive Processors* failed to think aloud on 7.2 pages compared to the 3.1 pages skipped by the *Active Processors*. However, unlike the *Single Processors*, the *Passive Processors* do not seem to rely on any particular strategy.

Rebecca was a *Passive Processor* who was read *Dragonflies*. Rebecca reported 17 processes, of which seven were different. Rebecca inferred several times throughout the course of the book. When we read about baby dragonflies, or nymphs, she concluded that, "That you can't see dragonflies when they are just babies." She also showed evidence of *processing graphics*. On the diagram that compares dragonflies to damselflies she pointed out that, "their tails are different when they are babies. This one has a tail like a fish [points to damselfly] and this one has a pointy tail [points to dragonfly]." She also noticed that the labels for the dragonflies' environments are reversed. Aside from these glimpses of processing, Rebecca was relatively non-active. Like many of the *Passive Processors*, Rebecca's verbal protocol is characterized at most by one process per page. Of the 21 pages in *Dragonflies*, Rebecca only used multiple processes on four pages. Rebecca chose not to think aloud on eight of the pages. While she is not a completely passive reader, her pattern of activity is relatively low and inconsistent.

Discussion

Instructional Implications

Differentiated instruction is only possible when a teacher has a clear idea of her students' strengths and weaknesses. Developing profiles of reading comprehension of informational text has the possibility of providing teachers with valuable information that could improve the way they meet their students' instructional needs. Below, I have briefly outlined some questions that one might consider when interpreting the reading profiles. I also propose some instructional implications for the different profiles. However, it should be noted that these profiles of reading are only based on one verbal protocol of one text. I strongly encourage teachers to examine students' patterns of processing across texts before labeling a student as having a particular profile.

Active Processors. These students were active, flexible, and independent when applying comprehension processes to the informational texts in this study. Because the comprehension processing of these students was arguably the strongest in this study, teachers might be less concerned about the comprehension processing of these students. However, teachers of *Active Processors* need to make sure that these students are active across a variety of genres, topics, and purposes for reading. Also, because the individual processes in this study are not sensitive to differences in quality, teachers need to do some additional investigating to make sure that these students are using the comprehension processes effectively and efficiently. For example, when a student makes a prediction, does she check on that prediction later on in the text? Similarly, is there a qualitative difference between a student who names a graphic as a "diagram" and a student who interprets that diagram to summarize the life-cycle of an animal?

Active Processors with Foundation Process(es). These students are also active in how they are constructing meaning from the informational texts in this study. However,

they rely heavily on a single process as they construct meaning. Additional research is needed to further investigate this profile. It may be this additional active profile leads to similar comprehension outcomes as the *Active Processors* profile. It may not matter that students rely on one process, as long as they have an overall high activity rate, report a wide variety of processes, and show some indication of monitoring. However, if this profile leads to poorer comprehension outcomes, then different instructional implications may be warranted.

Single Processor. These students tend to use fewer processes, both in range and in total, compared to their *Active Processor* peers. However, similar to the *Active Processors with Foundation Process(es),* when they are actively constructing meaning from the text, they rely heavily on a single process. These students would likely benefit from learning about, and practicing additional strategies. They have shown that they can actively process an informational text, they may just need additional scaffolding to apply a wider variety of processes on a more consistent basis.

Superficial and Active and Superficial Processors. These students are making a significant number of irrelevant comments and/or are just repeating what the text says. For those students who report many irrelevant comments, it is important to get them to monitor their own comprehension. Teachers might teach these students to ask themselves, "How does that help me understand the text better?" whenever they report a process in order to help them become more text-focused. Teachers need to help these students realize that being an active thinker is not enough when reading. Readers also need to apply processes effectively. Those students who are simply repeating the text need to be taught how to internalize the text. Teachers should question whether the

students who repeat frequently have much prior knowledge on the text topic. It may be that a lack of prior knowledge or other challenge is interfering with the meaning-making process. If the students do have prior knowledge but fail to activate it, teachers should work with them on making strong connections between the text and their prior knowledge.

Single Superficial Processor. Earlier, I discussed Cindy's verbal protocol. She made an overwhelming number of *narrativizing* and *irrelevant* comments. In some ways, Cindy resembles Wade's *Schema Imposer* profile (1990). The *Schema Imposer* is a reader who "holds on to an initial hypothesis despite incoming information that conflicts with that schema" (p. 118, 1990). In Cindy's case, when we began reading about *Salmon*, Cindy made the connection to a time when she and her Dad went fishing. However, she continues to attempt to fit this story to the *Salmon* text, even to the point of completely ignoring the text (hence the high number of irrelevant comments). While Cindy seems to understand that comprehension is an active process, the comprehension processes are tenuously related to the actual text. The way that Cindy processes *Salmon* is also reminiscent of Williams' studies (1993, 1998) of adolescent readers with reading disabilities. Similar to Cindy, Williams found that the comprehension of these students was frequently peppered with tangential background connections. These idiosyncratic background connections also seemed to hamper students' abilities to make accurate predictions and identify the themes of narratives. Cindy's verbal protocol was almost completely devoid of any comprehension strategy use. Interestingly, Cindy's COCA score was also very low. This is an indication that it is not simply a matter of Cindy not

being self-regulated in her use of comprehension processes. Rather, her processing issues seem to be more pervasive and significant.

Students like Cindy would likely benefit from guided comprehension instruction that begins with how to effectively connect to background knowledge. Miller (2002) encourages her primary grade students to distinguish between connections that help the reader understand just a "little" part of the text versus "big" connections that help the reader connect to important information in a text. Being able to make well-grounded connections will likely assist Cindy (and students like her) as she moves onto additional comprehension strategies.

Passive Processors. Students who fall under the *Passive Processor* profile are characterized by a relatively low activity rate when constructing meaning from informational texts. This profile seems related to what Buly and Valencia (2002, 2004) deem as "word callers" In their sample, 18% of students fell into this profile. Word callers are students who can read accurately and quickly but who fail to read for meaning. In other words, the words wash over them passively. (It should be noted that we do not know the decoding abilities of the students in this study. Therefore, it is possible that these *Passive Processors* may look more like what Buly and Valencia call "disabled readers" because they also have decoding issues along with comprehension issues. However, for the current study, these second graders fell into the *Passive Processor* profile in the absence of decoding or fluency demands.)

It would be interesting to compare the *Passive Processors* performance on the COCA to their verbal protocol performance. Compared to verbal protocols, which are very nondirective, the COCA directs students to apply different comprehension processes

on each page (Billman, Duke, Hilden, et. al, 2008). If a *Passive Processor* scored high on the COCA, a teacher might conclude that the student's passive performance on the verbal protocols may have resulted from a lack of self-regulated strategy use since the student processing was high when given directed prompts on the COCA. In this case, the teacher would want to encourage these students to self-regulate their comprehension processes when reading. For example, a teacher could ask a *Passive Processor* to mark places where he is actively thinking about what he is reading. This teacher could later conference with the student on his independent processing. In comparison, if the student scored low on the COCA in addition to being qualified as a *Passive Profile*, this would be indicative of more serious comprehension issues. Such students fail to be *Active Processors* (or are highly ineffective in their processing) even when given specific prompts. Teachers need to make sure that these students realize that "good reading" goes beyond reading fluently, but that "good readers" are thoughtful readers.

Passive Processors may benefit from some intensive strategy and process instruction. These students may need to see additional modeling of what active processing looks like. Direct explanation of how the processes and strategies work may also be beneficial to these students. They need to know when, where, and how to use these strategies and processes effectively (Duke & Pearson, 2002). Finally, these students need much guided practice in order to learn how to implement these processes when reading. If thinking in terms of the gradual release of responsibility model, the teacher is likely to have to carry the burden of the strategies or processes at first when working with these students (Pearson & Gallagher, 1983).

Interestingly, Buly and Valencia found that 60% of the Word Callers in their investigation were English Language Learners (2002). None of the three ELL students in this study fell into the *Passive Processor* profile. Instead, two of the three ELL students were *Active Processors with Foundational Process(es)* and the last was a *Single Superficial Processor*. Additional verbal protocol work should be done in order to investigate how comprehension processing is different for ELL students as compared to native English-speaking students; especially in the early grades when comprehension is developing. There has been a history of verbal protocol work that compares reading in a native language as opposed to reading in a second language; however this work has focused on older readers and not on informational texts (Davis & Bistodeau, 1993; Jimenez, Garcia, & Pearson, 1996).

Limitations & Future Directions

The need for additional study to examine relationships between verbal protocols (including profiles) and comprehension outcome measures is particularly great. Pressley and Afflerbach (1995) identified this as a high-need area within verbal protocol work. They argued that correlating verbal protocols with outcome measures would provide a way to validate the verbal protocol findings. Unfortunately, they also found that very few researchers have linked verbal protocols to comprehension outcome measures. Meyers and colleagues (1990) represent one exception to this rule. They established positive and negative between categories of processes for fourth and fifth grade students' think-alouds and their passage comprehension. For example, they found negative correlations between passage comprehension and students' inaccurate paraphrasing. They found strong positive correlations between inferring and revising of previous thinking and passage

comprehension. In contrast, Wade, Trathen, and Schraw (1990) used cluster analysis to identify five comprehension profiles. However, these profiles were not significantly associated with memory for text. However, Pressley and Afflerbach (1997) advise that we cannot conclude from this that Wade, Trathen, and Schraw's attempt at validation failed. Instead, they site the small sample size in the "good comprehender" profile led to small statistical power that made it all but impossible to detect anything than very large effects. This issue represents an interesting conundrum in verbal protocol research. The vast majority of verbal protocol work is done with very small sample sizes. In fact, Wade and colleagues study was somewhat an anomaly in this way. Their study had 67 participants, which is very large for verbal protocol research. The majority of verbal protocol work is done with fewer than 30 participants (Pressley & Afflerbach, 1995). For future related research, a cluster analysis could be performed on a large number of verbal protocols for younger readers with the profiles from this study. Also, future research needs to investigate methodologies and analyses that would make correlating verbal protocols and outcomes easier. For example, one potentially fruitful line of future research may lie in correlating verbal protocol results with a wider range of comprehension outcomes. Relationships with the ability to answer inferential and critical/evaluation questions, for example, could be explored.

The ability to examine the relationship between verbal protocol profiles and comprehension outcomes is important for several reasons. First, we need to know that these profiles are consequential if we want teachers to attempt to alter their instruction based on their students' profiles. While we might assume that *Active Processors* would have better comprehension outcomes than *Single Processors* or *Superficial Processors*,

this is an empirical question that is not addressed in the present study. Second, if the profiles are validated with respect to outcome scores, it would then make sense to examine the profiles in relation to different groups of students. For example, are readers with learning disabilities or are English Language Learners likely to have certain profiles? Finally, we need to know whether these profiles are associated with reading comprehension development. For example, is it the case that students usually start off as *Passive Processors*, then progress to the *Single Processor* profile before becoming *Active Processors*? These are all future directions for research.

The texts used in the study may be interpreted as a limitation. The alterations to the COCA texts (and related directions prior to the think-aloud) may have unduly influenced the verbal protocols. There was likely more text monitoring than there would have been without "mistakes." Also, because the books were read aloud to the students, it is unclear from this study how decoding abilities and the comprehension processes would interact. For example, it would be interesting to see how decoding issues for struggling readers would interact with how they process the text. This brings us to a wider issue in the field. Reading comprehension is such a dynamic and complex process that depends on various reader and text-related factors. The books used for this study were informational texts that focused on the life-cycle of animals (life sciences). Future verbal protocol studies could see how these children would process informational texts on other science topics such as the solar system (physical sciences), or how they would process pseudonarratives on these animals. In other words, future research could compare how children process different genres and topics. Similarly, research could compare how students' processes are affected by their motivation, prior knowledge, and other

individual factors. Finally, processing profiles of students in this study were based on one verbal protocol. Future research should examine the generalizability of the profiles to other texts. No one study can begin to capture the complexity of reading comprehension development. Rather, only by using a variety of methodologies will we begin to more fully understand how various reader and text factors impact how reading comprehension develops.

One limitation of the current study is the small sample size of 30 second graders. It is possible that additional verbal protocols may have revealed other reading profiles. While the present sample did not include any students that fit this profile, it is theoretically possible. This profile would include verbal protocols that include at least seven irrelevant and repeating comments, and would fail to meet the *Active Reading Profile* In this profile, these students would fail to be active and flexible in their processes they report. The comments would not likely be beneficial to their comprehension of the text. These verbal protocols would rely heavily on repeating and irrelevant comments. *Superficial Processors* who repeat the text frequently resemble Wade's *Non-risk Taker* (1990). She describes such a student as one who "assumes a passive role by failing to go beyond the text to develop hypotheses." However, the *Superficial Processor* would also make irrelevant comments that are not tied in any way to the text.

More research is needed to investigate individual strategy and process development. Throughout this study, I noticed many occasions in which students seem to be applying a process inefficiently. In memory research, Waters (2000) states that children can be inefficient in their strategy use by applying a strategy in a simpler or less effective form than their older peers. She then provides several examples of research in

which children have inefficiently applied memory strategies. From this verbal protocol study and my past work (2006), I see a similar trend with comprehension strategies. Perhaps it is not surprising that in second grade, children are learning about how to use new comprehension strategies. However, not all children automatically apply them effectively at first. Several questions emerge. First, can teachers effectively and reliably distinguish between efficient and inefficient strategies? Is it the case that students' comprehension processes naturally become more efficient over time through practice? Do students benefit from tailored instruction geared towards improving the efficiency of the processes? If so, what would such instruction look like? In this case, it looks like basic and applied research could greatly inform one another.

Another future direction for research in reading comprehension development is to examine whether it is (and how to make it) practical for teachers to use verbal protocols as a means to identify profiles of children in their classes. From looking at the verbal protocol research, the trend seems to be for researchers to collect verbal protocols from students that they have never met. One exception to this trend is a group of studies that involve teaching students to think-aloud as a strategy to improving their reading comprehension (Baumann, Seifert-Kessell, & Jones, 1992; Oster, 2001; Schunk & Rice, 1985, Silven & Vauras, 1992). While, verbal protocol researchers go to great lengths to minimize their influence, and make students comfortable, one possible research direction would be to see if students thought aloud differently when their teachers were present instead of unknown adults. Secondly, if teachers could effectively and reliably collect verbal protocols, this would be a step towards using verbal protocols as a classroom assessment tool. Finally, if teachers were to collect verbal protocols they might have

unique insights into the profiles and instructional implications. At the very least, a future step might involve sharing a range of verbal protocols with some effective second grade teachers and have them identify the students' strengths and weaknesses as well as discuss instructional implications for working with these students.

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Table 1

Breakdown of Ethnicity Percentages for Participating Schools

School	White, non-Hispanic	Black	Hispanic	Other
1	90.3	5.1	3.9	1.8
2	95.4	2.0	2.0	< 1
3	--	--	--	--
4	96.9	1.2	< 1	1.2
5	96.4	< 1	1.3	1.3

Note. These statistics are at the school level. Statistics for School 3 were not available. However, this school is in the same district as School 5. (National Center for Education Statistics, 2005-2006).

Table 2

District Demographics by Percentages and Locale Codes for Schools

Schools	Free & reduced lunch[a]	Residents with Bachelor's degree or higher[b]	Residents lower than high school education[b]	Children below poverty line[c]	NCES Locale Code
1	66	18	33	36	City: Small
2	23	27	4	8	Suburb: Large
4	5	34	7	6	Suburb: Large
3	21	20	6	6	Suburb: Large
5	16	20	6	6	Suburb: Large

Note. Demographic data is reported at the district level.

[a]Free & Reduced Lunch data is at the school level. (Center for Educational Performance & Information, 2006-7)

[b]US 2000 Census Bureau

[c]US Census Bureau (2005-6)

Table 3

The Number of Questions per Construct for Salmon and Dragonflies in the COCA

COCA Form	Processing Graphics	Text Features	Vocabulary	Comprehension Strategies
Salmon	4	2	9	4
Dragonflies	3	4	7	5

Table 4

Inventory of Processes from Verbal Protocols

Process	Examples
Comprehension Strategies	
Connections to prior knowledge: Student connects to a related topic (e.g., another type of animal), a form of media, personal experience, or another text (intertextuality).	*Dragonflies*, p. 10: "They're kind of like butterflies when they're first done shedding their skin except butterflies come out of chrysalises and it's different." *Salmon*, p. 7: "We learned about zooplanktons once. Um, I think it's those animals were on Sponge Bob. It's that animal one time that's all." *Dragonflies*, p. 14: "I've seen lots of different types of dragonflies. I've seen some that are green, some that are blue and some that are red and some that are blue and red." *Dragonflies*, p. 11 "It reminds me of books how they show how the animal that they're talking about, how it has body parts and stuff."
Previewing and predicting: Student comments about what the book will be about or what will happen next in the animals' life cycle, confirms or revises an earlier prediction, or previews a future illustration or graphic (always double-coded with *processing graphics*). Comments are worded as what will happen next, or what information future pages will contain.	*Dragonflies*, p. 1: "Um, I'm feeling like the story is giving an idea about like a life cycle or something like a dragonfly." *Dragonflies*, p. 8: "And now I'm thinking it is going to go out and find a mate and they have to mate and then they're the ones that will have eggs again."

Table 4 (cont'd).

	Dragonflies, p. 8: Student: Ohhh! I was right. Researcher: What do you mean? Student: That they were going to molt again. *Salmon*, p. 2 Researcher: I noticed that you were kinda looking over at this page. Were you thinking anything when you were looking at this page (Title page)? Student: Um… I think these are fish and they are kinda,… they're kinda swimming towards the eggs. And they are going to do something to them.
Inferring: These comments often take the form of guesses about additional details not explicitly stated in the text or graphic. Inferring was often an attempt to explain why something happens (*because* is a key word that often occurs). Inferring can be text or illustration-based.	*Salmon*, p. 8: "I think they eat, they hunt small fish because they can't hunt the big fishes…I'm thinking tries to eat it, the other big fish is going to eat it."
Summarizing: Comment captures the gist or main idea of a section of the book. Comments condense information from more than one sentence of text.	*Dragonflies*, p. 20: "The damselflies and butterflies and dragonflies are like the same. They come from eggs and then they come to like little babies and then they molt their skin two times and then they become adults."

Table 4 (cont'd).

Questioning/Wondering: A question about the text or illustration. "I wonder" is a common phrase.	*Salmon*, p. 18: "I'm wondering where did the water go?"
Questioning the Author: The student asks a question about something the author wrote or illustrator drew.	*Dragonflies*, p. 6: I'm wondering if the author actually knew the EXACT size of the nymph.
Monitoring Comments occur when students monitor their understanding of the text and illustration.	
Text Monitoring: Comment reflects confusion stemming from either the text or illustration.	*Dragonflies*, p. 18: "Um, I think that... I think that it is really hot in forests because I see like the sun out and it looks like a desert.... Hmmm, oh! That's not a desert (points to the picture of the forest) and that's not a forest (points to the desert). The forest goes here and the desert goes here (indicating that the pictures are reversed)." [This comment is double-coded with *processing graphics*]
Re-reading: Only coded when either prompted by the student or occurred because the student did not hear the text	*Salmon*, p. 15, "Can you repeat it?"
Knowledge Monitoring: Comment either 1) recognizes absence of prior knowledge or changes from previous thinking or,	*Dragonflies*, p. 5: "I didn't know that before."

Table 4 (cont'd).

2) recognizes that the text or illustration confirms previous thinking. These comments frequently feature, "I didn't know" in reference to content in the book.	*Dragonflies*, p. 18: "I think I know better now because I've been doing this because I didn't like really know about them and stuff and I was just getting into them and so this book will give me like a preview and stuff and helping me learn about them."
Activating Senses: Comment reflects activating visual, smell, or touch senses. (While possible, hearing and tasting were not present in the study's sample).	*Dragonflies*, p. 9: "I'm feeling wings...I'm feeling wings in my head. I can feel them in my head. (K: What does it feel like?) They feel like they are tickling my fingers."
Vocabulary[1]	
Student explicitly demonstrates understanding of word knowledge by explaining the meaning of a word that is not defined in the text. OR Student uses the surrounding text to infer word meaning of unfamiliar words. OR Student recognizes that they do not know the meaning of a specific word.	*Salmon*, p. 17: "I know that the male is the boy and the female is the girl."
	Dragonflies, p. 12: "And I'm feeling that where they breathe from is called spiracles on their abdomen."
	Salmon, p. 17: "What does spawning mean?" (Double-coded with questioning).
Processing Graphics	
Processing Graphics, Other: Comments either integrate information provided in the text and graphic, only interpret the graphics (could be made in absence of the text), involve two or more related graphics, or use the text to	*Dragonflies*, pp. 16 & 17: "Their tails are the same and their tails are different when they are babies. This one has a tail like a fish (points to damselfly) and this one has a pointy tail (points to dragonfly)."

Table 4 (cont'd).

understand the graphic.	*Salmon*, p. 5 Student: That doesn't make sense to me. Researcher: What doesn't make sense? Student: They're on the top (points to right side). They're eggs are on the top. And on this page they are on the bottom (points to the eggs on the left). Researcher: And you said that that doesn't make sense. Why doesn't that make sense? Student: Because it said it lays on the bottom, not the top. [This is also coded as monitoring]
Processing Graphics, Intratextuality: Student makes comparisons and connections between pages. (These comments are based on illustrations and/or graphics).	*Salmon*, p. 15 Student: The eagles and bears like to eat salmon just like the other page. It said that salmon are smaller than bears and bears are bigger so the bears will eat the salmon. Researcher: You said, "Just like the other page." What other page where you talking about? Can you show me? Student: Sure. (Flips to page 10). See on this page, that animal is bigger than that. And that, and that, and those animals are smaller. And if it is smaller, if the animal is bigger it will eat it and the bear is bigger than the salmon.
Text Features Knowledge Includes comments about the table of contents, index, glossary, labels, captions, and pronunciation guide. (The specific type of text feature is not coded).	*Dragonflies*, Glossary: "I think that the author put the glossary in so that if the author used some words that someone didn't understand they could look back and see what it meant." *Dragonflies*, p. 11 (Reading labels & captions): "That the mouth has

Table 4 (cont'd).

	parts in it too...They have jagged edges for chewing prey."
Evaluating Student evaluates the text or the illustrations. Comments can take the form of agreeing or disagreeing with the author or with the information in the book.	*Salmon*, Post: "This is a nice book to read when learning about fish in the ocean." *Dragonflies*, p. 9: "I don't think blood flows in the wings because whenever I look at dragonflies I don't see any red stuff, I just see white, white, white."
Affective reaction Student comments on emotional reaction to the content of the book. (This is separate from the empathizing process, where the student reports feeling emotion tied to animals.)	*Dragonflies*, p. 19: "I'm glad I got to read this book because ..."
Anthropomorphizing Student ascribes human characteristics and emotions to animals.	*Salmon*, p. 18, "I'm feeling when they die...they're like kinda scared if they're going die. It's like us. Like us if we're scared we're gonna die."
Empathizing Student identifies with animals or reports feeling emotion for animal. This is not double-coded with affective reactions.	*Salmon*, p. 12, "I feel bad for the little shrimp."

Table 4 (cont'd).

Restating Comment reflects paraphrasing of the text of a particular page. Student translates text using own words.	*Salmon*, p. 10, "Their scales on their bodies turn silver... I think they use to have um dots on them. And it use to, and it goes away because they got bigger."
Repeating Student repeats a part of the text verbatim or with very few minor changes.	*Salmon*, p. 8: "Um...that's when, when they are about one year old they hunt for minnows."
Word Identification Strategies to figure out how to read words. These strategies are not related to word meaning.	*Salmon*, Glossary: (Student recognizes that *saw* is in *spawning* and that this helps her read the latter.)
Narrativizing Student imposes a story structure/grammar onto the understanding of the text. These comments must be tied to the text or graphic on a page (otherwise code the comment as irrelevant). Student does not use generic nouns or timeless verbs when discussing the animals.	*Salmon*, p. 10: "I'm thinking that they'll all growed up and that they are all brothers and sisters."
Irrelevant Comments Comment that is not tied to the book or is about the activity itself. This process is only coded in the absence of other processes. OR Comment only names objects in pictures.	*Salmon*, p. 11: "How many pages are there?" *Salmon*, p. 2: "The eggs look like pink eyeballs."

Table 4 (cont'd).

Note. Code names are italicized.

[1]Exceptions for coding vocabulary: Comments on the Glossary for *Salmon* (p. 24, Item 17 & 18) are coded as vocabulary.

Comments on the pronunciation guide on p. 11 (Item 10) on *Dragonflies* are coded as vocabulary. These COCA items are coded as vocabulary.

Table 5

Rubric for Establishing the Quality of the Verbal Protocols Based on Students' Processes

	2	1	0
Accuracy			
Genre Accuracy	a. Student makes no narrativizing or anthropomorphizing comments & does not refer to the book as a story.	a. Student only makes 1-2 narrativizing or anthropomorphizing comments OR refers to the book as a story	a. Student tries to impose a story structure on book, frequently narrativizes, and/or anthropomorphizes the animals.
Interpreting Text Features	b. Student accurately interprets text features that are commented upon (e.g., glossary, index, and table of contents).	b. Student demonstrates a mix of accurate and inaccurate text feature knowledge, OR it is unclear how much a student knows about text features because comments are unrelated to the function of text features (e.g., makes a background connection).	b. Student consistently fails to accurately interpret text features such as the glossary and index.

Table 5 (cont'd).

Interpreting Diagrams	c. Student tends to accurately interpret diagrams. Student verbalizes at least 1 "mistake" where text & illustration do not match. (Dragonflies, p. 6 & 18; Salmon, p. 5, 14, 19).	c. Student tends to passively comment on diagrams (e.g., simply names labels). Student makes GCT comments on pages where there are "mistakes" but struggles to verbalize mistakes. Student comments on mistakes that are not present.	c. Student consistently inaccurately interprets diagrams or does not pay attention to relevant information presented in the diagrams. Student cannot accurately match up details in comparison diagrams. Student does not verbalize any "mistakes" where text does not match illustration.
Mis-conceptions	d. Misconceptions are very rare and are minor (detail-related) when they occur.	d. Misconception occurs as a result of the student making inaccurate inferences or misinterpreting a diagram. For example, "When the wings are all crunched up the sun dries them out and that's what makes them grow, makes them bigger."	d. Student's comments result in more than 1 misconception about the content in the text or illustration. The nature of the misconceptions is cause for concern as it relates to the main ideas of the text.

Table 5 (cont'd).

Quality			
Text-Based Comments	a. Comments are tied to the text & illustrations.	a. A few comments are superficially related to the text, however most are textually bound.	a. Multiple comments (such as prior knowledge connections) are off topic or superficially related to the text. For example, "The people that wrote this book are going to be good people because they wrote books to little kids and stuff."
Knowledge-Transforming Comments	b. Student use mostly knowledge transforming (active) processes and only make a few passive comments (restating & irrelevant).	b. Student use a mix of knowledge transforming (active) processes and passive comments (restating & irrelevant comments).	b. Many of the processes coded are passive and/or superficial (e.g., irrelevant/picture comments).
Presence of Monitoring	c. Student demonstrates an ongoing monitoring pattern (knowledge monitoring, text monitoring, or rereading) &/or follows up with previous thinking. (Monitoring comments cannot all fall under text monitoring subcategory.)	c. Student infrequently makes monitoring comments.	c. Monitoring comments are extremely rare or nonexistent.

Table 5 (cont'd).

Knowledge Monitoring Focuses on New Knowledge	d. Knowledge monitoring comments focus on what the student has learned from the text. For example, "I didn't know that..."	d. Knowledge monitoring comments rarely focus on what the student has learned from the text. (Student may have other types of monitoring comments such as those that reflect what the student still does not know. For example, "I don't know how they lay their eggs.") Student does not follow up on previous thinking.	d. Student never reflects on what she/he has learned.
Asking & Answering Questions	e. Student asks and attempts to answer at least one text-related question by either referring to text content or inferring.	e. Student asks text-related questions but does not attempt to answer these questions.	e. Student either does not ask text-related questions or the questions asked are superficial and are related to picture.

Table 6

Descriptive Statistics for the Four Contributors Measured by the COCA

Process	Total times coded	Number of students who used process at least once	Range in occurrences per student	Mean and (SD)
Comprehension Strategies				
Connections to Prior Knowledge	73	20	0-12	2.43 (2.81)
Previewing & Predicting	82	29	0-9	2.73 (2.07)
Inferring	60	24	0-9	2.00 (1.98)
Summarizing	22	12	0-4	0.73 (1.11)
Vocabulary	16	11	0-3	0.53 (.86)
Processing Graphics	151	30	2-15	5.03 (2.67)
Text Features	56	26	0-5	1.87 (1.20)

Table 7

Descriptive Statistics for Processes that Fall under the Contributors that are Measured by the COCA, but are not Directly Measured by the COCA

Process	Total times coded	Number of students who used process at least once	Range in occurrences per student	Mean and (SD)
Comprehension Strategies				
Questioning & Wondering	64	14	0-14	2.13 (3.61)
Questioning the Author	2	1	0-2	0.07 (.37)
Activating the Senses	8	4	0-3	0.27 (.69)
Monitoring				
Text Monitoring	28	20	0-4	.93 (.91)
Rereading	8	6	0-3	.27 (.64)
Knowledge Monitoring	43	19	0-7	1.43 (1.79)
Processing Graphics				
Intratextuality	24	12	0-4	0.80 (1.16)

Table 8

Descriptive Statistics for Verbal Protocol Processes that are not Measured Directly or Indirectly by the COCA

Process	Total times coded	Number of students who used process at least once	Range in occurrences per student	Mean and (SD)
Evaluating	14	9	0-6	0.47 (1.14)
Affective Reaction	12	7	0-4	0.40 (.93)
Anthropomorphizing	4	2	0-2	0.13 (.51)
Empathizing	5	3	0-3	0.17 (.59)
Restating	60	20	0-10	2.00 (2.57)
Repeating	19	8	0-5	0.63 (1.35)
Word Identification	5	4	0-2	0.17 (.46)
Narrativizing	26	6	0-12	.87 (2.54)
Irrelevant Comments	38	14	0-8	1.27 (2.16)

Table 9

Quantitative Processing Differences between Salmon and Dragonflies

	Total Processes	Different Processes[a]
Salmon (N = 16)	521	173
Mean	32.56	10.81
(SD)	(8.19)	(2.69)
Range	16 - 42	5 – 15
Dragonflies (N = 14)	299	125
Mean	21.36	8.93
(SD)	(6.92)	(2.02)
Range	9 – 36	6 – 12
Aggregate	820	298
Mean	27.33	9.93
(SD)	(9.41)	(2.55)
Range	5 - 42	5 – 15

[a]Different processes indicates the sum of the total number of different processes reported by the students.

Table 10

Proportion of Matches, Related Matches, Misses, and Non-Responses between Verbal Protocols and COCA Items for Salmon

	Comprehension Strategies	Processing Graphics	Vocabulary	Text Features	Across Contributors
Matches & Related Matches	.38	.36	.10	.81	.27
Misses	.39	.52	.65	.16	.54
Non-Responses	.23	.13	.24	.19	.20

Table 11

Proportion of Matches, Related Matches, Misses and Non-Responses between Verbal Protocols and COCA Items for Dragonflies

	Comprehension Strategies	Processing Graphics	Vocabulary	Text Features	Across Contributors
Matches & Related Matches	.47	.71	.03	.36	.32
Misses	.18	.19	.58	.30	. 36
Non-Responses	.35	.10	.39	.34	. 33

Table 12

Description, Criteria, and Frequency for Verbal Protocol Profiles

Profile	Description	Criteria
Active Processors	These students flexibly use a wide range of strategies and are actively constructing meaning from the text. These students are also monitoring their comprehension and are connecting what they read to their prior knowledge.	1. Student must use at least 7 different strategies. (This represents roughly a third of the total 22 strategies in the inventory). 2. Student must average at least 1 process per page + post (22 Dragonflies & 26 for Salmon). 3. Student must make at least 1 monitoring comment (text monitoring, rereading, or knowledge monitoring).
Active Processors with Foundation Process(es)	These students are actively and flexibly constructing meaning. In addition, they are also relying heavily on at least one process. Foundation processes observed include: processing graphics, monitoring, activating prior knowledge, inferring, restating, and questioning.	1. Student meets criteria for active processor AND 2. uses at least 1 process a minimum of 7 times.
Single Processors	The meaning construction of these students is dominated by a single process. These processes include (varying by child) predicting, questioning, and activating prior knowledge.	1. Student does NOT meet criteria for active processor AND 2. uses a single process at least 7 times

Table 12 (cont'd).

Active and Superficial Processors	These students meet the criteria for active processors but also make frequent superficial comments.	1. Student meets criteria for active processor AND 2. makes at least 7 irrelevant and/or repeating comments.
Single Superficial Processors	Meaning construction is primarily a mix of a single process and superficial comments.	1. Student meets the criteria for single processor AND 2. makes at least 7 irrelevant and/or repeating comments.
Passive Processors	These students report a low level of cognitive and affective activity and are not using a wide variety of processes.	1. Student does not meet criteria for active processor AND 2. fails to use a single process more than 6 times.

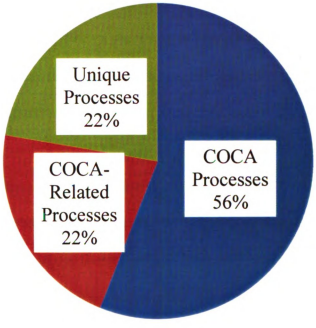
Table 13

Frequencies Broken Down by Form (Salmon & Dragonflies), Total Number of Processes, Number of Different Processes, and Maximum Number of Reports for Most Frequently Reported Process for Reading Profiles

Profile	N	Total Processes (Means & SD)	Different Processes (Means & SD)	Maximum Process (Means & SD)
Active Processors	3	30.67	11.67	5.00
	(2D, 1S)	(5.69)	(.58)	(1.00)
Active Processors with	11	36.45	11.80	10.09
foundation process(es)	(3D, 8S)	(5.96)	(1.60)	(2.84)
Single Processors	5	22.20	8.00	7.40
	(2D, 4S)	(5.78)	(1.10)	(0.55)
Active and Superficial	1	27	12	8.00
Processors	(0D, 1S)	(--)	(--)	(--)
Single Superficial	1	26	5	11
Processor	(0D, 1S)	(--)	(--)	(--)
Passive Processors	9	18.11	8.44	4.55
	(8D, 1S)	(4.20)	(2.24)	(1.24)

Figure 1

Percentages for Process Breakdown



Note. Images in this dissertation are presented in color.

Appendix A

Script for Think-aloud Sessions

The researcher introduces herself and asks the student to accompany her to a quiet place where they will not be disturbed. Researcher obtains student's verbal assent. The researcher begins by asking the child if he or she wants to hear his or her voice on the tape recorder as a way to introduce the recording device. The researcher then briefly demonstrates how the tape recorder works.

Training for Puzzle Activity

The researcher introduces the puzzle activity.

"Today I am going to watch as you try to put this puzzle together. You are going to work on it for about five minutes. It is a really hard puzzle so you may not be able to finish it in five minutes. It is not important how fast you can do it or even if you can solve it. Rather, I really want to know about what you are thinking as you put the puzzle together. Since I cannot read your mind or see inside your head, I would really like for you to tell me what you are thinking and feeling as you put the puzzle together. There are no right or wrong answers. In fact, anything you can tell me would be helpful as I am interested in learning more about how students like you think. You can stop and tell me what you are thinking any time. But sometimes I will stop you and ask you to think aloud for me. (Researcher will ring bell once a minute for five minutes.) Before starting the researcher asks, "Is there anything you're thinking before you start?"

After the child answers researcher replies, "Great, go ahead and try to put it together." After each minute the researcher will ask, "Stop for a moment and tell me, what are you thinking about, or what are you trying to do right now?"

After the five one-minute segments the researcher says, "Now I want you to stop working on the puzzle. Is there anything else you want to say about what you are thinking or feeling before we move on?" After student's reply researcher says "I will show you how to solve the puzzle once we are done with the next activity" (if student is unable to solve the problem in the allotted time). The researcher removes the puzzle from the table so it will not be a distraction for the student.

Before Think-Aloud for Book

"I really appreciate you telling me what you were thinking as you put the puzzle together. That was good practice for what we are about to do. I love to read books to second graders. I am going to read this book to you. Do you notice anything that is different about this book than other books you've read before?" (Student should notice that the words are missing and that there are lines on the bottom of the page). "I am going to read the words that go on each page. I will point to the page that I am reading." (Demonstrate for student: page 8 & 9 for *Salmon*, page 4 & 5 for *Dragonflies*). "Also, in this book there may be a few pages where the authors or illustrator made mistakes. For example, the picture may not match what the words say on the page. If you see a mistake, be sure to let me know."

Researcher introduces the directions for thinking aloud.

"Now before we start, I have some directions. What I am really interested in is hearing your thoughts and feelings about the book as I

read it to you. So just like the puzzle where you told me what you were thinking and feeling, I want to know what's going on inside your mind as you read. You can stop and tell me what you are thinking whenever you want. That is okay. Remember, just like the puzzle, there are no right or wrong answers. Also, do you see these yellow dots? I will stop and ask you to tell me what you are thinking and feeling when I get to each yellow dot. Sometimes there may be places where the book is not making you think or feel anything. If this happens you can shake your head no or tell me that you are not thinking anything and we will go on. Also, it is okay if you want to flip through and look at pages. Finally, if you want to hear any of the pages again just ask and I will reread the page to you. Can you tell me the directions so that I know you understand please?"

(Clarify any misconceptions and review directions as needed). When student repeats the directions check to see that three main points are captured: 1) Can think aloud at any time, 2) Have to think aloud after yellow dot or say, "I'm not thinking anything" and, 3) Can ask to reread.

"I showed you the tape recorder before and now I would like to record you as we read. This will help me remember what you talk about later. Do you have any questions?"

During the Think-Aloud.

Follow-up prompts:

- The researcher asks for clarification when the meaning of the student's comment is unclear. For example, the researcher may ask for further explanation by

repeating the student's comment and saying, "Can you tell me a little more about what you are thinking?", "What made you think that?", or "What did you mean when you said, [insert child's words]?"

- The researcher prompts when student responds nonverbally (e.g., makes a face, shrugs, eyes dart between pages, flipping pages) or makes a noise (e.g., laughs, grunts). For example, if a student's eyes are traveling between pages the researcher will prompt, "I noticed that you were [insert behavior]. What were you thinking when you were doing that?"

Referencing Illustrations:

- When a student points to an illustration or graphic, the researcher marks the place in a photocopy of the book for later reference. If the researcher is unclear about where a student is looking she asks, "Can you show me where you mean?" or "Can you point to where you are looking?"

Prompting at yellow dots:

- At each yellow dot the researcher asks: "What are you thinking or feeling?" or "Think-aloud for me." (Sometimes it is not necessary to prompt at this point because the student gets in the habit of thinking aloud once he/she reaches the yellow dot. At that point asking the prompt can interrupt the child's talking and thoughts.) If a child chooses to skip talking-aloud more than three times (at yellow dots) the researcher reminds the student that, "Remember that it is really important for you to share what you are thinking and feeling when we get to these yellow dots."

After the Think-Aloud.

"Now that we are finished reading the book do you have any other thoughts or feelings that you would like to share with me?" The researcher models how to put puzzle back together again with help from the student. The session ends by thanking the child and asks if she or he wants to hear his or her voice on the tape recorder. The student then returns to the classroom.