Executive Function, Self-Regulated Learning, and Reading Comprehension: Training Studies

Supplementary Information

Pilot Study Conditions

There were three conditions. Students in the Control condition received only pre-test and post-test, and instruction in their regular classroom setting. There were two active conditions, Text Based (TB) and Text Based Plus Executive Function (TB+EF). There were 10 sessions of approximately 35 min each, that occurred daily for 2 weeks in May, 2013. Both active conditions covered the same content (on early state history) from a 4th grade history textbook (Pearson, 2003). Each active condition was centered around text passages of approximately 200 to 400 words, which was read in sections of about 75 to 125 words.

On the first day, for each condition, the study purpose was briefly reviewed (e.g., finding ways to improve reading understanding), along with group rules (respect for one another, stay on task, one person talks at a time, have fun) before instruction began. Each group moved at their own pace, but each session typically covered a single section of text (depending on their length). Over the 10 days of intervention, approximately 11 passages were covered (the time period from about 1820 to 1850).

TB Condition. For each text passage, there were 6 activities (listed with approximate time per session for each activity): vocabulary cards (5 min); word skim (1.5 min); read-aloud text (10 min); answering text-based questions with scaffolding (8 min); summarizing (6 min); and text review (5 min). Throughout, tutors completed a small chart for the group for on-task behavior/participation; stickers were awarded based on that chart at the end of each days' session.

For the 1st activity (*vocabulary cards*), students were shown the title of each passage, along with a list of one to vocabulary concept words within the passage, each of which was associated with its definition, a picture, related words, a sample sentence, and examples. These vocabulary cards were introduced in four steps: (a) tutor says the word clearly, and students repeat chorally; (b) tutor provides a student friendly definition, that again, students repeat chorally; (c) tutor provides a visual aid related to the word and encourages discussion; (d) tutor provides related words, uses the word in a sentence, and provides examples of the concept. The 2nd activity was

word skim. The tutor reads the title and asked students to skim the passage for words with which they were unfamiliar, and the tutor assisted with their pronunciation. For the 3rd activity (*read-aloud text*), the tutor then called upon a student to read a section of the passage, assisting the student with any necessary words (e.g., when student pauses for 3 seconds or mispronounces words). During the 4th activity (*text-based questions*), the tutor called on a student to answer a question whose answer could be found in text. If a student could not answer, the tutor scaffolded the student by identifying a portion of the text (e.g., "look *here* at the second sentence") and delimiting as needed (e.g., "look at *this part* of the sentence"), until the student correctly answered the question. This process was repeated for two additional questions. In the 5th activity (*summarize*), the tutor asked a student to summarize the passage ("Tell me what this passage was mainly about"). Dialogue between student and tutor was used to encourage a brief recap that did not entail re-reading of the passage. Activities #3, 4, and 5 were repeated for each text of the passage, with student roles rotated. The 6th activity was *re-reading*; students silently re-read the entire passage for consolidation.

TB+EF Condition. First day procedures were similar to those of the TB condition, with review of study purpose, and group rules covered. However, a process for reading for understanding was also briefly reviewed with the group that emphasized components of self-regulated learning and processes associated with executive function. This included activities prior to reading, during reading, and after reading. The tutor explained *Before* reading activities as being "ready" to read, paying attention, thinking about what is known about the topic, and setting a goal for the passage about to be read. To assist with goal-setting, students were provided a list of "goal-stems" as a way of assisting with potential goals (who, what, where, when, how, why, and reading X% of the words). The tutor explained *During* reading activities as "monitoring" one's reading and to "checking-in" with themselves. Emphasis was placed on the process of check-in rather than specifically how this was done, although several examples were repeatedly provided (e.g., thinking about what words mean, thinking about how one sentence follows from the one before it, evaluating if the goal is being addressed, asking questions to

oneself about the reading). Finally, the tutor explained *After* reading activities as thinking about what the

passage means through summarizing, evaluating if the goal was met, asking oneself if the text was understood.

Motivation was addressed by the provision of stickers along with feedback for good work (e.g., reading

a passage well; summarizing efficiently; identifying whether a goal was met; good behavior). In these cases, the

feedback was immediate, positive, and specific ("Jamey, that was an excellent summary of that passage – it was

both short and hit the major highlights; see if you can get the next one as well"; "It seemed like that was a

difficult passage to read, Jamey; there were a lot of hard words, but I liked your effort in trying to sound out *this*

word and *that* word"). Tutors awarded stickers and provided feedback to students as they were earned. In

addition, wherever possible, students were given a choice (of goals, of words to be defined, of which student

will do which activity).

As with the TB group, each TB+EF session typically covered about 1 passage (depending on their

length), so that approximately 11 passages were covered, and the total amount of text covered in the two

conditions was similar. For each passage, there were 10 activities (with approximate time for each activity):

titles (2.5 min); goals (1.5 min); vocabulary cards (2 min); potentially unknown words (1 min); get ready (2

min); read-aloud text (10 min); check-in/understanding (2 min); summarize (8 min); goal-check (2 min); and

quizzing (5 min).

Several activities of the TB+EF group overlapped with those of the TB group, but with some differences

in implementation. For the 1st activity (*titles*), students were shown the title of the passage, and asked to "say

what they know" about the title, or what the passage might be about. For the 2nd activity (*goals*), one student

chose a "goal stem" for the group (students were reminded that they may have a separate goal for themselves).

In the 3rd activity (*vocabulary cards*), the same four-step procedure as the TB group was followed, except

students chose just one of the concept words to help equate overall time spent on each passage. For the 4th

activity (*potentially unknown words*), a pre-selected list of potentially unfamiliar words from the passage were

all read to the group, and two different students chose a word that they would like defined (and then the tutor provided a definition). For the 5th activity (*get ready*), students were briefly reminded: (a) to take a deep breath to focus; (b) to keep in mind the group goal, and (c) to prepare to "check-in" with themselves while reading (with occasional examples given). The 6rd activity (*read-aloud text*), was similar to that of the TB group of the same name. For the 7th activity (*check in/understanding*), students made a mark on a sheet that indicated whether they actually did check in with themselves and whether they understood the text. The 8th activity (*summarize*) was similar to that of the TB group (i.e., "Tell me what this passage was mainly about"), although here, if a student struggled to summarize, help was solicited from the remainder of the group, and always ended with a tutor-supplied summary of the passage. For the 9th activity, the tutor asked if the group goal was met or not, and if so, how. Activities #5, 6, 7, 8 and 9 were repeated for each section of the passage. Unlike the TB condition, where the tutor called on specific students for each activity, students volunteered for activities in the TB+EF condition (with the tutor ensuring that all students participated if necessary). Finally, for the 10th activity (*quizzing*), students were given a 5-item multiple-choice quiz that covered the entire passage. Answers were reviewed after the quiz was administered. The Table provides summary data for the pilot.

Table. Pre-Test and Post-Test Descriptive Statistics By Group for Pilot Study

	TOTAL			CON			TB			TB+EF		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Age	31	9.67	0.73	12	9.90	0.67	9	9.79	0.98	10	9.29	0.35
Attendance	19	9.16	1.01	--	--	--	9	9.11	1.05	10	9.20	1.03
WJ-III LWID	31	92.68	13.00	12	88.50	11.33	9	95.22	18.01	10	95.40	8.97
TOWRE-2 SWE	31	88.55	15.19	12	84.33	13.74	9	93.11	20.99	10	89.50	10.04
WJ-III PC	31	91.35	11.45	12	86.67	11.19	9	95.11	13.91	10	93.60	7.92
Background (Science)	31	4.42	1.67	12	4.33	1.97	9	5.00	1.00	10	4.00	1.76
Background (History)	31	3.42	1.57	12	3.92	1.44	9	4.00	1.41	10	2.30	1.34
Pretest Proximal	31	0.45	0.22	12	0.54	0.21	9	0.46	0.26	10	0.33	0.11
Posttest Proximal	31	0.56	0.22	12	0.51	0.23	9	0.65	0.19	10	0.54	0.21
Posttest Related	31	0.42	0.19	12	0.40	0.19	9	0.45	0.26	10	0.42	0.13
Posttest Unrelated	31	0.44	0.23	12	0.40	0.28	9	0.50	0.19	10	0.45	0.20

Note: WJ-III: Woodcock Johnson Tests of Achievement, Third Edition; LWID: Letter Word Identification (Standard Score); PC: Passage Comprehension (Standard Score); TOWRE-2 SWE: Test of Word Reading Efficiency-2 Sight Word Efficiency Subtest (Standard Score). See Table 1 for other abbreviations. Attendance is in days (maximum 10). Background measures are raw scores (maximum 12). Proximal: material covered in training but actual text unique (history); Related: material related in general content to taught material, though not covered (history of a different time); Unrelated: unrelated material (science). Pretest and posttest texts are percent correct.

Experiment Study Conditions

As in the Pilot, there were three conditions (again, TB, TB+EF, and Control). The topic remained the same, but the specific passages were written specifically for this study. Each active condition was centered around text passages of approximately 200 to 400 words, which itself was divided into shorter passages of approximately 75 to 125 words. Passages were divided the same way in both conditions. Each condition was delivered in each school.

On the first day, for both groups, the structure and sequence of the sessions was previewed, along with behavioral expectations and reward system. The latter were set up as a points system, with students gaining points for specific fixed events (e.g., appropriate entry, silent/oral reading), as well as at unexpected times (Surprise Time! denoted by a small random timer twice per session). Points could be exchanged for small prizes at regular intervals. In both conditions, feedback was provided to students frequently, in a manner that was immediate and specific (similar to that of the TB+EF condition in Study 1).

Each session typically covered a single section of text (depending on their length). There was a maximum of 16 lessons over a maximum of 21 days of instruction, with individual sessions ranging from 30 to 45 min (depending on school schedule, though without group differences; see below under procedures). Also, on the first day for both groups, three short unrelated passages were used to demonstrate the structure of the lessons. For the first passage (on volcanoes), the tutor led the group through the passage, talking through each step; for the second passage (general information on the states), the tutor solicited "help" from students in the group; and for the third passage (on state symbols), the tutor encouraged students to perform all steps, with help as needed.

TB Condition. For each text passage, there were 6 activities (listed with approximate time per session for each activity): potentially unknown words (2 min); word skim (1 min); read-aloud text (18 min); answering text-based questions with scaffolding (4 min); summarizing (3 min); and quizzing (4 min).

The 1ˢᵗ activity was *potentially unknown words*. Here, a pre-selected list of 7 potentially unfamiliar words from the passage were all read to the group, with pronunciations and definitions. The 2ⁿᵈ activity was *word skim*. The tutor reads the title and asked students to skim the passage for words with which they were unfamiliar, and the tutor assisted with their pronunciation. For the 3ʳᵈ activity (*reading text*), the tutor called upon a student to read a section of the passage, assisting the student with any necessary words (e.g., when student pauses for 3 seconds or mispronounces words). This was followed by a second reading, which each student performed silently. During the 4ᵗʰ activity (*text-based questions*), the tutor called on a student to answer a question whose answer could be found in text. If a student could not answer, the tutor scaffolded the student by identifying a portion of the text (e.g., "look *here* at the second sentence") and delimiting as needed (e.g., "look at *this part* of the sentence"), until the student correctly answered the question. This process was repeated for two additional questions. In the 5ᵗʰ activity (*summarize*), the tutor asked a student to summarize the passage ("Tell me what this passage was mainly about"). Dialogue between student and tutor was used to encourage a brief recap that did not entail re-reading of the passage. Activities #3, 4, and 5 were repeated for each text of the passage, with student roles rotated. The 6ᵗʰ activity was *quizzing*, where students answered a 4-item multiple-choice quiz that covered the entire passage that was just read. Students were encouraged to answer all the ones they could in 4 minutes, and all questions were answerable from text. The quiz was reviewed after it was completed by students.

TB+EF Condition. First day procedures were similar to those of the TB condition, with review of study purpose, and group behavioral expectations and reward system covered. In addition, a process for reading for understanding was also briefly reviewed with the group that emphasized components of self-regulated learning and executive function. This included a specific discussion around motivation, as well as activities prior to reading, during reading, and after reading. The tutor explained *Before* reading activities as being "ready" to read, paying attention, thinking about what is known about the topic, and setting a goal for the passage about to

be read. For students in this condition the goal was always to find out what the passage is about and what is happening in the passage. The tutor explained *During* reading activities as "monitoring" one's reading and to "checking-in" with themselves. Emphasis was placed on the <u>process</u> of check-in rather than specifically <u>how</u> this was done, although several examples were repeatedly provided (e.g., thinking about what words mean, thinking about how one sentence follows from the one before it, evaluating if the goal is being addressed, asking questions to oneself about the reading). Finally, the tutor explained *After* reading activities as thinking about what the passage means through summarizing, evaluating if the goal was met, asking oneself if the text was understood. The same point-based system used in the TB condition was used here.

As with the TB group, each TB+EF session typically covered about 1 passage (depending on their length) per session, and the total amount of text covered in the two conditions was similar. For each passage, there were 7 activities (with approximate time for each activity): titles (2 min); vocabulary cards (3 min); potentially unknown words (1 min); get ready (1 min); read-aloud text (19 min); summarize (3 min); and quizzing (4 min).

Several activities of the TB+EF group overlapped with those of the TB group, but with some differences in implementation. For the 1st activity (*titles*), students were shown the title of the passage, and asked to "say what they know" about the title, or what the passage might be about. For the 2nd activity (*vocabulary cards*), students were given a choice of words, and a student chose a word, which was introduced with the same 4 step process in Study 1 (word is stated; definition provided; visual-aid provided with discussion; related words/examples of use). For the 3rd activity (*potentially unknown words*), a list of 5 pre-selected list of potentially unfamiliar words from the passage were read to the group, with their pronunciations and definitions. For the 4th activity (*get ready*), students were reminded to prepare for text reading, with varying reminders about how all the text is connected, the goal to find out what the passage is mainly about, and to have in mind questions they might ask themselves while reading (e.g., "Do I understand that sentence I just read?"; "How

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does this sentence relate to the title?"). The 5th activity (*reading text*) was similar to that of the TB group of the same name, except that in-between the oral and silent reading, students gave examples of ways in which they "checked-in" with themselves, with tutor feedback provided. The 6th activity (*summarize*) was similar to that of the TB+EF condition from Study 1 (i.e., "Tell me what this passage was mainly about"). Again, activities #3, 4, and 5 were repeated for each section of the passage. Unlike the TB condition, where the tutor called on specific students for each activity, students volunteered for activities in the TB+EF condition (with the tutor ensuring that all students participated if necessary). Finally, for the 7th activity (*quizzing*), students were given a 4-item multiple-choice quiz that covered the entire passage. Two of these items overlapped with the analogous passage of the TB group, but one question specifically focused on a new vocabulary word, and another question was always some form of "What is the main idea of this passage"? Students also set a goal for how many of the questions they expect to answer correctly, and then evaluate this against their performance, when answers were reviewed.