

## **Technical Details**

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# **Working memory training for foreign language practitioners**

## **Study findings**

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Foreign language practitioners (FLPs) frequently work under stressful situations; tight deadlines, rapidly evolving geopolitical situations, and high consequences for failure can all influence their job performance. Even under the best of conditions, however, all FLPs are limited by their own cognitive performance, including the limits of their attention and memory resources. Frequently, too, the source material that FLPs work with is degraded in some way: incomplete, distorted, incoherent, or garbled. The challenge for the FLP, then, is to assemble interpretations that are both accurate and coherent, in part by bringing their cognitive resources to bear on the problem.

This challenge may be best understood as a more extreme case of the challenges that all listeners face in language comprehension. Readers and listeners perceive linguistic input incrementally, and make interpretations ‘on-the-fly’ instead of waiting until an entire utterance has completely unfolded, and they occasionally have to make use of extra-linguistic information in order to interpret an utterance. For example, anaphors are discourse occurrences which refer to objects in the world somewhat obliquely; as a category, they include things like pronouns ("she" or "they", e.g.) pointing to referents that appear elsewhere in the discourse, and also deictics like "here" or "this", which have no other explicit reference in the discourse but must be pulled in from surrounding context. Consider, for example, the sentence "what is this?", uttered while pointing to an object. In these cases, the referents must be held in storage until they can be integrated appropriately. In addition, parenthetical asides can disrupt the flow of a sentence and separate the subject and verb of a sentence by several seconds, and this is another case when listeners and readers must hold information in some kind of store before they can appropriately process it. Therefore, although FLPs face far-reaching difficulties in their work, these difficulties are not unique to what they do, and research to understand the relationship between working memory and language processing is directly applicable.

## **The working memory system**

Many modern theories of human cognition describe a single system that is dedicated to the temporary processing, maintenance and holding of information that is relevant to current tasks; this is the system of working memory. Many theoretical models exist to describe its operation (see the variety of opinions offered in Miyake & Shah, 1998), but its function remains similar: it orders, stores and manages immediate sensory details until they can be properly incorporated into the cognitive process that must integrate that data. The amount of data that can be stored for immediate, accurate recall (*availability*) is limited in size, and the speed

with which it can be recalled (*accessibility*) varies. Ideal working memory function, then, would increase both the accuracy of recall and the rate at which information in working memory can be accessed.

### *Working memory and language*

Working memory is an important component in many learning processes, including taking notes, following directions, or ignoring distractions (Piolat, Olive & Kellogg, 2005; Engle, Carullo & Collins, 1991; Engle, 2001). Evidence suggests that it is also an important part of language comprehension. Speakers with larger working memories are better able to learn vocabulary (in both first and second languages), write more proficiently, and have better reading and listening comprehension (Atkins & Baddeley, 1998; Daneman & Hannon, 2007; Engle, 2001). In addition, previous work at CASL determined that FLPs who have been more successful with tasks involving ambiguous materials frequently have, among other things, larger working memory capacities (Weems et al., 2007). Individual differences in working memory, then, are likely to play a role in differentiation among FLPs, with the predicted result that those who have more capable control of their working memory are also more likely to be higher performing FLPs.

### **The training of working memory**

Fundamental to CASL's work in this area is the assumption that general cognitive abilities such as working memory can be improved through experience and training. Traditionally, cognitive abilities have been assumed to grow throughout childhood and peak in early adulthood before stabilizing and perhaps beginning to decline with age. Work in recent years, however, indicates that working memory processes can change through experience and practice (Mahncke et al., 2006; Westerberg & Klingberg, 2007).

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## **METHOD**

Ten USG employees (8 females; mean age=44.5 years) participated in a study to test the effectiveness of working memory training. A secondary purpose of the study was to gauge the interest in such training within this population. We recruited participants through internal organization emails, and all participation was strictly voluntary. Of our 10 participants, eight were working full-time as FLPs and the other two were performing more administrative tasks within the same organization.

Participants were screened for basic eligibility requirements: they had to (a) be between the ages of 18 and 60; (b) be able to use their dominant hand without difficulty; and (c) have no personal history of neurological or psychiatric disorders or learning disabilities. Because working memory performance drops with age, it was important that the pool of participants be as controlled and uniform as possible. Research of this type ordinarily restricts the age-range of participants to between 18 and 40; because this population skews older, we expanded the study to include participants up to the age of 60, and in practice the ages of participants ranged from 27 to 60, with a median age of 48. The other two eligibility requirements are standard norming factors for cognitive research.

The first and last two hours of the study were a scheduled appointment with a researcher, completing tasks that assessed a number of performance measures both before and after the training. The interim 10 hours of the study were working memory training. All assessments and training were presented on a CASL laptop (appropriately secured for use in cleared spaces) that was loaded with E-Prime scripts for the assessment tasks and Posit Science's *Brain Fitness Classic* Program. Participants completed portions of this training regimen that were selected by CASL to maximize benefits to foreign language professionals. The training was self-paced and self-directed; the laptops were left with the participants who were encouraged to try to complete an hour a day, and instructed to finish the entirety of the training within 3 work weeks (15 working days). Two participants were assigned to each laptop and left the freedom to coordinate their training schedules as worked best for them.

## Assessment tasks

The pre- and post-assessment tasks were selected to (a) accurately test both working memory and linguistic performance and (b) at a conceptual level, mirror as accurately as possible the tasks performed by FLPs.

*Air Force Officer Qualifying Test – Reading Comprehension (AFOQT)* – This timed portion of the larger AFOQT standardized test measures the ability to read a passage in English and answer questions about it. The test materials were adapted from an AFOQT practice exam and administered according to the instructions for the practice exam (Officer Candidate Tests, 2005). The test was computer delivered. The test consisted of 20 passages and corresponding multiple-choice questions. Two measures were derived from this test: response time (measured in milliseconds from the time the passage appears on screen until a response is provided) and accuracy (the percent of questions participants answered correctly). A sample reading passage and the corresponding question is included in the Appendix.

*Garden Path Sentences* – So-called "garden-path" sentences are frequently used in psycholinguistics studies to examine what interpretation commitments readers and listeners make to sentences as they unfold moment by moment. Garden path sentences serve as an illustration of the kind of real-time language processing that listeners and readers must carry out. Because they encounter language incrementally, sometimes readers reach erroneous conclusions about where a sentence is going and will have to repair their readings to incorporate new information. These repair strategies tax working memory, as readers must be able to remember what came in the first part of the sentence in order to incorporate it into a new structure (see Christianson et al., 2006, for materials used in the current study).

Consider a well-known example, "The horse raced past the barn fell", which exploits the fact that "raced" can be, ambiguously, either the simple past tense and the passive participle of the verb "to race". Because it occurs more frequently in the past tense form, most readers typically construe this sentence to mean, at first, that the horse raced by the barn. However, upon encountering, 'fell', they realize that this interpretation is incorrect and instead must recover the following interpretation: "The horse *that was* raced past the barn, fell". While readers and listeners frequently revise successfully, they occasionally do not (Christianson et al, 2006).

In this experiment, participants encountered stimuli that were manipulated to encourage these kinds of difficulties and force them to employ repair strategies. Consider the following pair of sentences:

*As the student prepared the salad that was healthy and fresh remained in the refrigerator.*

*The salad that was healthy and fresh remained in the refrigerator as the student prepared.*

Participants read these sentences and then answer questions like, "Did the student prepare herself?" The first is a garden path sentence; upon first encountering it, the most natural reading might be to treat the salad as the object of the sentence, since the verb "prepare" quite naturally takes "the salad" as a direct object. This is the "ambiguous" version of this sentence. The second is not a garden path sentence; the reordering makes it clearer that the student is the one being prepared. The expectation is that participants who have received working memory training might perform better on ambiguous sentences, because they might be better able to recover from their erroneous interpretations (i.e. reject the analysis that the student prepared the salad and recover instead that she was preparing herself).

The task is computerized for delivery. Sentences are presented on a screen, and participants must push a key to advance to the next screen, where they are presented with the comprehension question. Participants then respond to the comprehension question by pushing the keys designated "yes" or "no". There are a total 115 sentences, split into blocks of 57 and 58, with a break for participants between the two blocks. Within each block are 6 "ambiguous" sentences, 6 "unambiguous" sentences, and 45 or 46 distractors, and items are randomized within blocks. Due to a programming error, all data presented in the "Results" section is from block one.

The measures for this task are reading time, the time (in ms) it takes for a participant to read the sentence and request the comprehension question. We also measured reaction time, which is the time in ms that it takes for participants to read the comprehension question and register a response. Finally, we examined accuracy, which is the percentage of correct responses to the comprehension questions.

*Wechsler Abbreviated Scale of Intelligence (WASI)* – The assessment included the matrix reasoning section of the WASI materials, administering a possible total of 18 items in 9 minutes. The WASI matrix reasoning test measures nonverbal fluid reasoning, presenting an incomplete, abstract gridded pattern and requiring participants to select the correct piece to complete it from among five possible choices. The test was modified for computer presentation and selections were made by clicking on the appropriate figure. The critical scores from the test were reaction time, which measures the time (in ms) elapsed from the time the figure and question first appear on the screen until the participant records a response; and accuracy, which is a percent measure of the number of correct responses. A sample item from the WASI is included in the Appendix.

*Cloze Tasks.* Cloze tasks are a modified reading comprehension task, requiring testers to understand context and vocabulary even though words or phrases have been removed or redacted from the text. This study used SAT reading comprehension passages and questions (taken from Brownstein, Weiner, & Green, 1994, and Claman, 1997), modified to remove words from the text. In the construction of these materials we focused on (a) maintaining a consistent deletion rate of about 0.5% of the words in a text; (b) strategically deleting material that would make the comprehension questions answerable but perhaps more difficult; and (c) if possible, disrupting long-range constructions that might involve significant working memory components, including anaphors and their referents. These materials are still under development and are included in this study as a validating measure. An excerpt from one of the cloze tasks is provided in the Appendix.

*Automated listening-symbol span task.* This is a quintessential dual-task working memory span task and is based on a task described by Daneman and Carpenter (1980). It combines listening comprehension with a test of short-term memory for words to emulate the simultaneous processing and storage demands that are the hallmark of working memory. The task was automatized for computerized delivery according to the procedure described by Unsworth, Heitz, Schrock, and Engle (2005). It consisted of three parts: (1) a brief symbol memory practice task, (2) a sentence listening and comprehension task, and (3) the sentence listening and symbol memory tasks combined (the listening-symbol span task).

For Part 1, the symbol span practice, the objective was to remember symbol strings for immediate serial recall. The symbol strings consisted of two non-repeating symbols from a pool of nine symbols. Following a 500-ms fixation point (“+”) at trial onset, each symbol was presented serially at the rate of one symbol per second. Recall was cued immediately following the last symbol. The recall screen consisted of a 3×3 grid of the nine possible symbols with instructions at the top of the screen to recall both symbols in the order presented. A check appeared to the left of each letter as it was selected, and symbols that were selected appeared in a row at the bottom of the screen. Participants could click a button marked “Blank” to mark the serial position of symbol(s) they could not recall. A button marked “Clear” could be pressed to clear all of the symbols and begin recall again. When recall was finished and participants were confident in their response, they pressed a button marked “Next” to begin the next trial. A total of 3 letter strings were presented for recall.

For Part 2, the sentence listening and comprehension task, the objective was to listen to short, nine- to fourteen-word sentences, and indicate whether the sentence was semantically plausible (“The squirrel stored some nuts in the tree in preparation for a long winter”) or implausible (“On their first visit to ketchup, they took a formal tour”). Sentences were played one at a time on a computer, and participants listened with headphones. As soon as the sentence stopped played, buttons labeled “True” and “False” appeared on the computer screen with the question, “Did the sentence make sense?” Participants used the mouse to click the button corresponding to their answer. The task ended when 12 sentence judgments were made.

Finally, for Part 3, the sentence listening and symbol memory span tasks were combined. A 500-ms fixation point (“+”) appeared at trial onset followed by a semantically plausible or implausible sentence. Participants listened to the sentence and answered true or false, as in Part 2. A to-be-remembered symbol then appeared on the screen for 1 s. Sentences and symbols were presented in this manner until the set size was reached. As in Part 1, symbol recall was cued immediately following presentation of the last symbol in the set. The task had 12 sentence-and-letter sets, three of each set size from three to six. Three practice trials (set size = two) preceded the real test. Scoring: one point was awarded for each symbol recalled in the correct serial position. The mean proportion correct per set is the listening span score.

## The training regimen

The training regimen was abbreviated from Posit Science's *Brain Fitness Classic* program and consisted of combinations of five different kinds of 15-minute training exercises (Posit Science, 2008; for more information on this product, please see [http://www.positscience.com/products/brain\\_fitness\\_program/](http://www.positscience.com/products/brain_fitness_program/)). Tasks are designed to keep trainees on the threshold of their best performance: as they improve on the following tasks, the computer dynamically adjusts to their level and makes the tasks harder (e.g., asks a trainee to remember more and/or pay closer attention). Posit Science has multiple training programs; we chose the *Brain Fitness Classic* for this study because it focuses on auditory and language related memory, a critical component of work for FLPs.

The *Brain Fitness Classic* program is designed as 40 hours of training, using six different types of exercises that tax auditory working memory in different ways. Because the participants of this study could not spare too much time during their work days, the training was abbreviated to 10 hours and CASL researchers devised an abbreviated training schedule that would both bolster their basic auditory memory skills and encourage them to integrate those skills into larger abilities. The modified training schedule appears in Table 1.

**Table 1. Training schedule**

Day	Task 1	Task 2	Task 3	Task 4
1	High or Low	Tell Us Apart	Sound Replay	Story Teller
2	High or Low	Tell Us Apart	Sound Replay	Listen & Do
3	High or Low	Tell Us Apart	Sound Replay	Story Teller
4	High or Low	Tell Us Apart	Listen & Do	Story Teller
5	High or Low	Tell Us Apart	Sound Replay	Listen & Do
6	High or Low	Tell Us Apart	Sound Replay	Listen & Do
7	High or Low	Tell Us Apart	Listen & Do	Story Teller
8	High or Low	Tell Us Apart	Sound Replay	Story Teller
9	High or Low	Tell Us Apart	Sound Replay	Listen & Do
10	High or Low	Tell Us Apart	Sound Replay	Listen & Do

The training exercises were as follows:

High or Low– Listeners were presented with a series of different audio tones and were asked to designate the pitch of the tones. As the exercise progresses, task difficulty is increased along these dimensions: more tones were added to the sequence, the tones became briefer in duration, or the pitch tones became closer together.

Tell Us Apart – Pairs and triples of phonemes were presented in a series and listeners had to recreate the series. The exercise becomes more difficult when the program manipulates the phonemes to make them more acoustically identical, making differentiation more difficult.

Sound Replay – This exercise required the listener to sequence a set of syllables; the syllables were played auditorily and listeners had to click on written representations of those syllables in the proper sequence. When the participant successfully completed enough exercises for the program to progress to the next level, the sequences become longer and individual tokens began repeating, making the sequences more challenging to remember.

Listen and Do – Listeners carried out a series of audio instructions by manipulating objects and characters around graphic interface. As the task difficulty increases, the series of instructions becomes longer and more variables are introduced into the graphic interface, leaving the participant with more commands to hold in memory and more possible wrong choices.

Story Teller– This exercise presented a listener with an audio narrative and then asked the listener to answer questions about it. The exercise increases in difficulty by presenting a longer, more detailed audio narrative and requiring the listener to answer more specific questions.

“High or Low” and “Tell Us Apart” are the building blocks of the program, meant to build the most basic auditory memory and discrimination, and therefore form the backbone of the training regimen, with more repetition than other exercises. “Listen and Do” and “Story Teller” are higher level audio memory tasks, more likely to obviously approximate the tasks performed by FLPs. “Sound Replay” bridges the gap between those two sets of tasks. Data about performance has been transmitted to Posit Science for analysis and will be made available at a later time.

## RESULTS

The findings from the empirical study demonstrate general trends in improvement of performance after working memory training. The graphs below are all representations of mean values; the error bars represent standard error. Because this study works with only 9 participants, most of the findings are not significant, and should therefore not be interpreted too broadly; these data suggest trends and hint at more broadly applicable findings.

### Decreases in reaction time

Across tasks, this is where the most change occurred after working memory training; participants were generally quicker to respond after their working memory training, suggesting that their training had left them better able to rapidly retrieve information from their working memory and implement their responses. AFOQT average reaction times dropped by 9.88%, although not significantly,  $t(8) = 1.22$ , *ns*. Reaction time on the WASI improved by 32.9%, a significant change as indicated by a paired-subjects t-test,  $t(8) = 1.99$ ,  $p < 0.05$ . (See Figures 1 & 2 for reaction time on the AFOQT and WASI, respectively.)

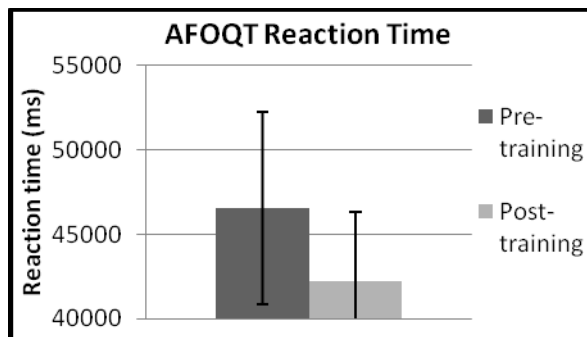


Figure 1. AFOQT Reaction Time

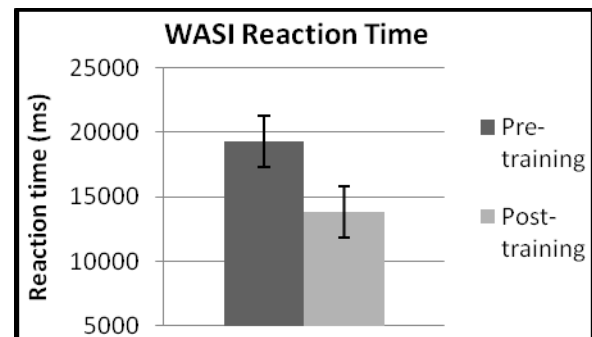


Figure 2. WASI Reaction Time

The garden path task saw a marginally significant decrease in reaction time for comprehension questions about unambiguous sentences, while the reaction time for the ambiguous sentences stayed about the same,  $t(8) = 1.81$ ,  $p = 0.05$ , and  $t(8) = -0.70$ , *ns*, respectively. (See Figure 3.) There was no significant difference in reading time between pre and post training, although we did observe the expected and well-attested result that ambiguous sentences take longer than unambiguous sentences for participants to read.

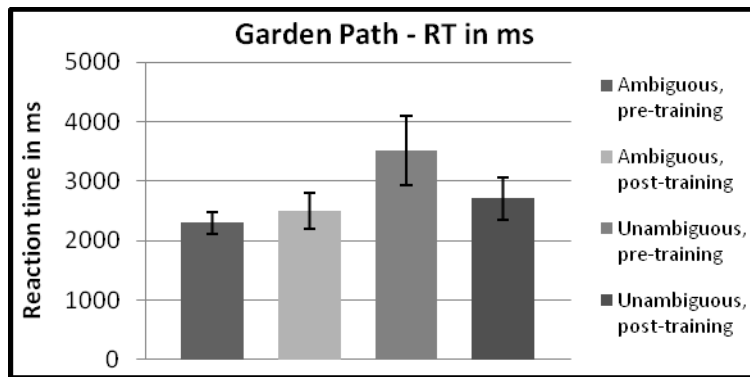


Figure 3. Garden Path Reaction Time

### Increases in accuracy

The listening span task demonstrated a small, non-significant increase in overall score,  $t(8) = -0.48, ns$  (see Figure 4), and a significant decrease in accuracy-related errors (see Figure 5) after working memory training,  $t(8) = 2.10, p < 0.05$ .

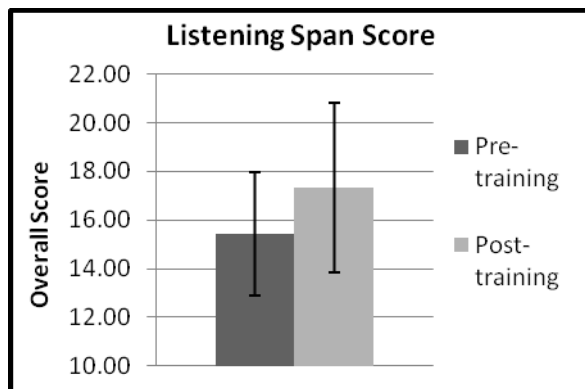


Figure 4. Listening Span Overall Score

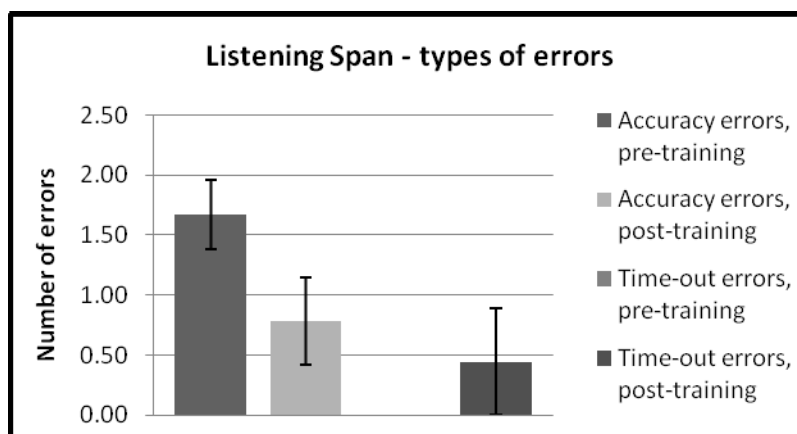


Figure 5. Listening Span Errors by Type

In addition, there were small increases in mean accuracy, perhaps reflecting greater comprehension on both kinds of stimuli in the garden path task, although the changes in neither the ambiguous nor the unambiguous were significant,  $t(8) = -0.80, ns$  and  $t(8) = -1.57, ns$ , respectively. (See Figure 6.)

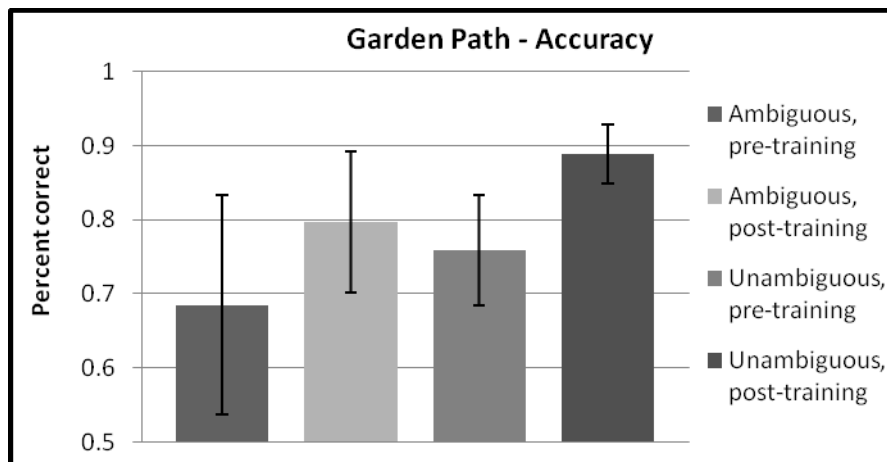


Figure 6. Garden Path Accuracy

There were no real changes in accuracy on the Cloze task, nor on the WASI or the AFOQT; the effects on these last two tasks were seen in reaction time.

### Increases in completion rate

The AFOQT, which is a timed test, showed a trend toward a small but not significant,  $t(8) = -0.94, ns$ , increase in completion rates, meaning that after working memory training, participants were on average better able to complete more of the test than before. (See Figure 7.)

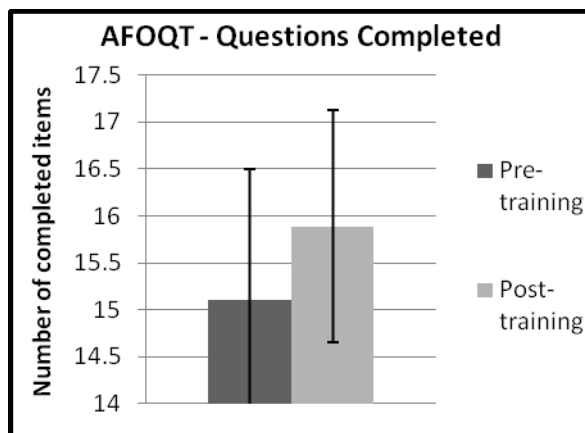


Figure 7. AFOQT Completion Rate

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## DISCUSSION

There are multiple ways in which the data suggest that participants experienced an increase in working memory capacity and language processing as a result of the working memory training. Reaction times tended to drop on both a simple reading comprehension task (AFOQT) and a nonverbal abstract problem solving and



spatial reasoning task (WASI). Participants' responses were more accurate on a dual-task working memory task (listening span) and a linguistic ambiguity resolution task (garden path). Finally, on average, participants completed slightly more of the AFOQT reading task after the training than before. These results are also consistent with the participants' subjective appraisals of the efficacy of the training, which is discussed in more detail below.

## **Considerations**

Although these assessments demonstrated some improvements between pre and post measures, there are reasons to be cautious about overextending generalizations based on this data.

### *Small group of participants and lack of control group*

CASL originally sought to recruit 20 participants for this study, but repeated attempts to enroll more than 10 failed. A larger group would be predicted to yield more robust and reliable results. Similarly, with no control group to compare against the training group, it is impossible to conclude whether people's improvement was genuinely the result of the training or simply due to a retest or "placebo" effect.

### *Unavailability of Posit Science training data*

Coupled with the previous consideration is the current unavailability of the Posit training data; Posit Science is currently reorganizing and has been less responsive than anticipated, and CASL is still working to retrieve the data reports. Although all participants report having completed the training regimen, that is currently unverifiable. This means that CASL cannot attempt to correlate training completion and performance with assessment performance, and cannot speak with more certainty about the relationship between them. Members of our team are currently working to access that data and begin analysis; we anticipate an addendum to this report that will address this correlation specifically by February 2010.

### *Short training period*

The Posit Science training regimen is designed for 40 hours of training; because of the nature of their work schedules, participants in this study completed only 10, and it is difficult to predict the outcomes possible after such a short training period. The assessment data suggests that this group saw improvements in their accuracy and reaction time, but CASL predicts that more thorough training would produce larger benefits.

### *Practical concerns*

Users were instructed to finish the training within 21 days, but the mean for the completed study was 29 days, more than a week longer than requested. However, for maximum benefit, the training is designed to be completed in a more concentrated period of time. Just as with other kinds of training and exercise, the density of training across a period of time is as important as the sheer volume of the training. Part of this difficulty may have been due to simple logistical issues; although participants reported no difficulty with the sharing arrangement, it is possible that it made timely completion more complicated. In fact, one participant mentioned that it would have been easier to do the training if it had been available online, perhaps indicating that she had some trouble with the arrangement. More commonly, users reported trouble fitting the study into their schedules. Because CASL is well-aware of the highly variable nature of FLP workflows, the regimen and schedule were designed for maximum flexibility, allowing participants to complete 15 minutes at a time according to their own schedules. This may be both an asset and a liability, though, as those who most successfully completed the training during the recommended period quickly built schedules for themselves that they followed more rigorously, a fact that suggests that this kind of training may be more successfully completed in the format of a regularly scheduled course.

## Feedback from participants

After the completion of the study, CASL sent an email to the participants to survey them about their experience in the study, asking how they completed their training and whether they thought they had improved or found the experience useful. Of the 10 participants, one was unable to complete the training at all; she had been re-tasked almost immediately after enrolling in the study and was subsequently unable to find time for the training. Because of the highly variable demands of their work, most participants had some trouble fitting in the training. Those who were most successful scheduled their time more rigorously, treating the training more like a formal course. All participants reported that they felt they had improved over the course of their training, but a few were unsure how that would translate to their job. A few others continued to express interest in a longer working memory training course.

Excerpted below are some of their responses:

- “I think that the training was very useful, because I have to do a lot of memorization for language work, and it was helpful to me for that.”
- “I may have improved a little, but not much because I didn't follow the ‘everyday’ instruction – which I feel would make a HUGE difference.”
- “It was intriguing, especially the task exercises, but I don't think they seemed particularly relevant or useful for what I do.”
- “I would still like to have a chance to complete the entire program sometime in the future.”
- “The strategies have stuck with me. I tend to respond more efficiently to work tasks now.”
- “I found the training to be very useful. I think it is very relevant to the work of a language analyst in helping to improve concentration, memory and discriminating slight differences in sounds. I would really like to have a program like ‘Tell Us Apart’ for the sounds in my target language.”

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## CONCLUSIONS

### Future work

The previous section listed several considerations to keep in mind regarding the impact of the current study, and one possible follow-up to this work could be additional studies. CASL is currently conducting research at the University of Maryland that expands this investigation considerably; that project examines the effects of 20 hours of working memory training in both English L1 and English L2 (i.e., non-native English speaking) populations, and the findings from that research may bolster and reinforce claims about this training's utility.

Continuing to work with the Posit Science materials retains some complications inherent to the present work; all data recorded about the training is encoded in a proprietary format and must be sent to Posit for decrypting and compilation, and this has proven troublesome. The hope is that the current difficulties encountered in obtaining the data will prepare the CASL team for any larger-scale studies. In addition, CASL is currently developing and testing its own tasks, the data from which is easily extractable and examined by CASL researchers, and those may be worth waiting for.

This is further complicated by the technical requirements necessary for delivery in secure spaces. CASL was able to secure only five laptops that were acceptable for use in secure space, and this represents a considerable constraint on what is possible. CASL believes that a web-deliverable product is ideal in this circumstance, and has begun work to prepare one.

This study offers some preliminary evidence that task performance can be improved through working memory training and CASL is continuing work that may support that proposition. Previous work on this project suggests that improved working memory can be of use to FLPs. Finally, the follow-up email survey demonstrates that participants enjoyed the training and perceived it to be relevant and of use in their work lives, and therefore feasible to implement with some important modifications and considerations. Taken together, a useful conclusion is that a formal training program in memory retrieval techniques, attentional control, and

memory training could aid FLPs in their job performance. The relative success of participants who structured their training program as a daily task (as opposed to those who took better advantage of the study's design flexibility) may also suggest that this training is better suited to be a more formalized training program. One participant in this study proposed that this kind of training could be especially useful and appropriate for new hires, especially those who are beginning their employment with the USG and may be participating in other training programs while waiting for their taskings and clearances to be completed, and that seems to be a reasonable suggestion.

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## APPENDIX – SUPPLEMENTARY MATERIALS

### AFOQT

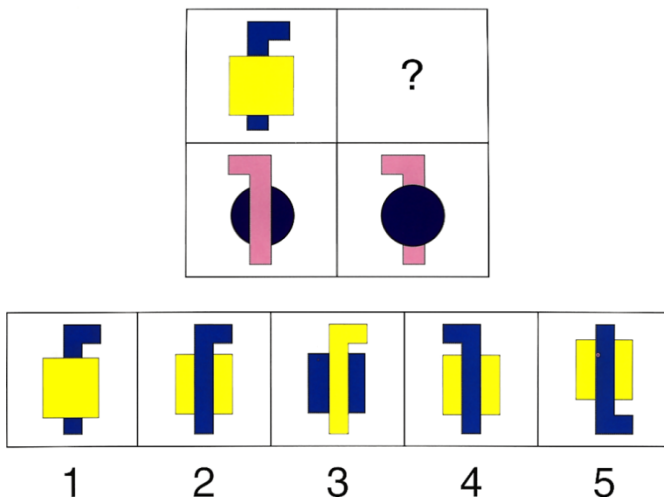
Included is one item from the AFOQT test.

We had to acknowledge that he was still at the peak of his maturity, although he had been at precisely that point for as long as we could remember. Old age seemed as alien to his being as callow youth. There was about him

- a) an inexplicable perpetuity.
- b) a childish frivolity.
- c) an intense desire to live.
- d) an apparent change with time.
- e) a quality of old age.

### WASI

Below is one item from the WASI inventory. Recall that participants examine the graphic on top and select with a mouse which of the options along the bottom row is the best completion of the pattern.



### Cloze Task

Reproduced here is one question set from the administered Cloze Task. Each test consisted of two passages of similar length and complexity; although the number of questions per passage varied, each complete test contained 10 questions.

5 Dramatizations of imprisonment and escape are so all-pervasive in nineteenth-century literature by women that we believe [redacted] represent a uniquely female tradition in this period. Interestingly, though works in this tradition generally begin by using houses as [redacted] symbols of female imprisonment, they also use much of the other paraphernalia of “women’s place” to enact their [redacted] symbolic drama of enclosure and escape. Ladylike [redacted] and costumes, mirrors, paintings, statues, locked cabinets, drawers, trunks, strongboxes, and other domestic furnishings appear and reappear in women’s novels and poems. They signify the woman [redacted] sense that, as Emily Dickinson put it, her “life” has been “shaven and fitted to a frame”, a confinement she can tolerate only by believing that “the soul as moments of escape / When bursting all the doors / She dances like a bomb abroad.” Significantly, too, the [redacted] violence of these “moments of escape” that women writers continually imagine for themselves reminds us of the phenomenon of the mad double\* that so many of these women have projected into their

10 [REDACTED]. For it is, after all, through the [REDACTED] of the double that the female author enacts her own raging desire to escape male houses and male constructs, while at the same time it is through the double's violence that the author articulates for herself the costly [REDACTED] of anger repressed until it can no longer be contained.

15 \*mad double: a literary device in which a seemingly insane character represents certain aspects of a conventional character's personality

1. In this passage, the list of objects in lines 4-5 serves to suggest
  - a. the lavishness of domestic furnishings
  - b. the precarious economic position of women
  - c. society's concern with surface rather than underlying truth
  - d. the limitations placed on women
  - e. the threat of violence in the home sometimes faced by women
2. In this passage, Dickinson's perception (lines 6-8) is similar to views expressed by other women writers of her era in that it
  - a. hints at the intensity of the urge to be free
  - b. asserts that only those who have experienced freedom directly can appreciate it
  - c. conveys the impression of belonging to a larger whole
  - d. affirms that there is but one correct way to behave
  - e. suggests that only those who work well with others will be able to achieve freedom
3. In this passage, the inclusion of Dickinson's description of the soul (lines 6-8) reinforces the suggestion that women's desire for escape is
  - a. a potentially violent longing
  - b. suppressed during childhood
  - c. not a common wish
  - d. worth risking danger to achieve
  - e. hardly ever realized
4. In this passage, the word "constructs" (line 11) refers to
  - a. literature written by men
  - b. definitions of masculinity
  - c. physical objects men have created
  - d. rules for building and architecture men create
  - e. sets of ideas established by men

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