

Short Term Memory Trial Study

HON 198 Honors Project

by

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Introduction

You thought you were just coming for a complimentary lunch and a show. But no... you have to work for it by taking a short term memory test. Today we will be using a simple visual word recall list form test available on the brain fitness channel's website <http://bfc.positscience.com/eval/wlr.php>. First we'll go to test your brain; then click the word list recall.

The test consists of a series of 15 words flashed for one second each. You will read and attempt to remember the words. After all 15 words have finished flashing I will prompt you to pick up your pencils. You will then write all the ones you remember in the first survey slot. Thank you for your participation.

Short Term Memory (STM) is the ability to hold information in our mind for a few seconds. Normal STM tends to be about 7 items, give or take 1 to 2. According to the Brain Channel's website, the average twenty year old remembers 7 of 15 words and the average 80 year old only remembers 4 of them. Be prepared to laugh at yourself.

Have you ever had trouble remembering something? Perhaps you were just reciting a phone number and the moment you got a chance to write it down, some of the numbers may have disappeared. Well this kind of memory loss otherwise known as Short term memory was happening way too often to me, for my personal comfort. You see, I had taken a diversities course in American Sign Language. It was my first course since high school. I need to tell you, I love sign language. However, it can be difficult to make words from finger-spelling. I found that when people finger-spelled a word at me I could scarcely hold on to more than three to four letters at a time, the rest of the word would disappear from

my memory like smoke in a breeze. Now, I already have a couple of disabilities, so I expected to experience some struggles. However, after everyone else in the class seemed to be competent forming words out of finger-spelling I was still writing each individual letter down to hold on to the memory of the previous letters.

My lack of STM became a point of embarrassment for me. It actually got to the point where I called my husband on the phone after I left class one day and cried to him. Poor guy he had worked overnight, but he came all the way to college to share some lunch and console me when he should've been sleeping. Although I felt frustrated and defeated I was also humbled enough to visit the school's reading lab. It was there, that a kind woman pulled up the 2004 study; Short Term Memory Span: insights from sign language, <http://www.nature.com/natureneuroscience>. It says although informational STM is limited to 7 ± 2 items the STM for using ASL differs to 5 ± 1 items. After reading the study, I found it was likely I needed to be more forgiving with myself. However, I wasn't sure how forgiving I should be when taking my disabilities into account.

Essentially my spring board for the study came from personal frustration of not being able to form words of the easily identified signed alphabet. This study has become my spring board in my quest to discover a realistic expectation of the STM of adults with minimum special needs studying sign language, compared to hearing, Deaf, special needs and bilingual individuals.

Project Description

Things started happening fast after I started working with my Honors Professor Robyn Toman from the Mathematics Department. She has supported me wholeheartedly throughout my quest. Our experiment was based on the one word recall test from the Posit Science website. In fact our hearing and special needs groups recorded their answers on the survey directly from the random word list recall available on the website. We had a total of 21 hearing students and 8 special needs persons who voluntarily participated in the written word recall STM trial study. (*By the way when I mention special needs, I'm referring to students who have DSS accommodations here at AACC or those with memory and or cognitive disabilities.*) There was a series of fifteen words flashed one word per second. We did three trials for each group in the study.

The next issue we faced was how to give STM trial study in American Sign Language (ASL). I suggested a film of me signing words that I had learned in my ASL 1 course and my ASL communications second level course. The words I used were ones that I commonly used in conversation with my Deaf and hard of hearing friends; this way I wouldn't blank while in front of the camera. Robyn then contacted the Instructional Design department to shoot a film of me signing forty five words broken into a series of three trials (*that's fifteen words per trial*). Joseph Goforth of the AACC Instructional Design Team filmed the DVD and allowed me to help him edit it. We took a little under two hours to complete this part of the experiment. My signing did alter this test from the written version. I averaged one sign per two seconds; that is one more second per word than the written recall test. The time I used per word is similar to the study; Short-Term

recall by *Deaf Signers of American Sign Language: Implications of Encoding Strategy For order Recall* (Hanson). I also had a couple of bloopers in the first and third trials. Because we already had the DVD in hand I suggested we add a plus to each of those trial scores according to the amount of mistakes I'd made. We used the ASL DVD version of the STM test on our Deaf, bilingual and beginning ASL groups. (*By the way when I say bilingual, I mean fluent in both English and ASL only.*) We had 6 Deaf participants, 10 bilingual volunteers and 3 beginning ASL students who voluntarily participated in the ASL DVD version of the word recall STM trial study.

The following lists of words represent the 3 trials given to all participants including both the written word recall lists, and the ASL words from the video.

Trial 1

Written Word Recall -1 word/second

Rigging
Ear
Octopus
Hoard
Friend
Somewhat
Focus
Short
Quarter
Niece
Seed
Mend
Volume
Helpful
Throne

ASL Word Recall – 1 word/ 2 seconds

Favorite (signed wrong, signed birthday)
Honest
School
Book
Again
Texas
Night
Opera (signed wrong, should finger-spell)
Late
Pig
 $\frac{1}{2}$
Green
Pet
Goal
Sheep (signed wrong)

Trial 2**Written Word Recall**

Wheel
 Person
 Oatmeal
 Turnip
 Find
 Light bulb
 Soldier
 Round
 Jacket
 Fork
 Spider
 Distance
 Pavement
 Symptom
 Candle

ASL Word Recall

Read
 Good
 Paper
 Called
 Pen
 Other
 Fun
 Dance
 Drunk
 Dog
 Son
 Year
 Teacher
 Sun
 Egg

Trial 3**Written Word Recall**

Folder
 Quiet
 Mission
 Veranda
 Alligator
 Sailboat
 Clue
 Treasure
 Sauce
 Cookie
 Web
 Tailor
 Motivation
 Pencil
 Freeze

ASL Word Recall

Spider
 Milk
 Student
 Dog
 Father
 Friend
 Camera
 Bathroom
 Pizza
 Hungry
 Art
 Mean
 University (wrong)
 Bad
 End (wrong)

Data Collected

The data we collected during the study had some surprising results. After running some basic summary statistics on each of the five groups, several patterns became obvious. The hearing group had an average of around 7 remembered words with a high score of 12 and a low score of 5. The high score of the hearing group far exceeds those of the average person mentioned on Eric Chudler's report *Neuroscience For Kids* from 2006 (Chudler). Whereas the special needs group averaged between 4 and 5 remembered words with a high score of 7 and a low score of 3, which is congruent with other studies where the average was 5 words recalled (Lee Swanson 3). It is interesting to note that the special need's group high score was the same as the average of the hearing group's.

Please see the summary statistics for the hearing group and the special needs students on the following pages.

Written Word Recall: Hearing n = 21

Summary Statistics	Trial 1	Trial 2	Trial 3
Number	21	21	21
Mean	7.76	7.24	7.48
Standard Deviation	1.66	1.34	2.04
Minimum	5	5.	2
First Quartile	6.5	6	7
Median	8	7	7
Third Quartile	8	8	9
Maximum	12	11	11

Trial 1	Trial 2	Trial 3	Per Person Average
9	8	11	9.3
8	8	7	8
10	11	10	10
7	6	6	6
7	6	7	7
8	9	9	9
8	7	4	6
7	8	7	7
6	6	8	7
7	5	9	7
8	8	8	8
8	7	9	8
5	6	5	5.3
11	7	7	8.3
8	7	7	7.3
12	7	10	9.6
8	8	7	7.6
6	7	9	7.3
8	8	8	8
6	8	7	7
6	5	2	4.3
Average	Average	Average	
7.4	7.47	6.55	

Written Word Recall: Special Needs n = 8

Summary Statistics	Trial 1	Trial 2	Trial 3
Number	8	8	8
Mean	4.9	4.25	4.5
Standard Deviation	1.54	1.09	.5
Minimum	3	3	4
First Quartile	3.5	3	4
Median	4.5	4.5	4.5
Third Quartile	6.5	5	5
Maximum	7	6	5

Trial 1	Trial 2	Trial 3	Per person Average
5	3	4	4
7	5	5	5.6
6	5	5	5.3
4	3	4	3.6
7	6	5	6
3	3	4	3.3
4	4	5	4.3
3	5	4	4
Average	Average	Average	
4.9	4.25	4.5	

The results of the groups tested with the ASL video were as follows. The Deaf group's average score was between 3 and 6 remembered words with a high score of 9 and a low score of 2. These results are congruent with other studies which had an average of about 5 recalled words from deaf students (Hanson 194). The bilingual group had an average score between 4 and 6 with a high score of 9 and a low score of 2. These results are congruent other studies which had an average of between 4 and 5 recalled items (Gutierrez-Clellen 8).The

beginning ASL group had an average score between 5 and 6, with a high score of 8 and a low score of 4.

Please see the summary statistics for the bilingual, deaf and beginning ASL groups on the following pages.

ASL Word Recall: Bilingual n = 10

Summary Statistics	Trial 1	Trial 2	Trial 3
Number	10	10	10
Mean	5.5	4.1	4.2
Standard Deviation	1.5	1.3	1.72
Minimum	3	2	2
First Quartile	5	3	3
Median	5.5	4.5	4
Third Quartile	6	5	5
Maximum	9	6	7

Trial 1	Trial 2	Trial 3	Per Person Average
6	2	2	3.3
6	2	3	3.6
4	3	4	3.6
5	4	7	5.3
5	5	5	5
6	5	7	6
6	6	2	4.6
3	5	3	3.6
5	5	5	5
9	4	4	5.6
Average	Average	Average	
5.5	4.1	4.2	

ASL Word Recall: Deaf n = 6

Summary Statistics	Trial 1	Trial 2	Trial 3
Number	6	6	6
Mean	5.7	5	3.7
Standard Deviation	1.89	1.83	1.28
Minimum	3	2	2
First Quartile	4	4	2
Median	6	5	4
Third Quartile	6	6	5
Maximum	9	8	5

Trial 1	Trial 2	Trial 3	Per Person Average
6	6	2	4.6
3	5	3	3.6
6	2	2	3.3
9	4	4	5.6
6	8	5	6.3
4	5	5	4.6
Average	Average	Average	
5.6	5	3.5	

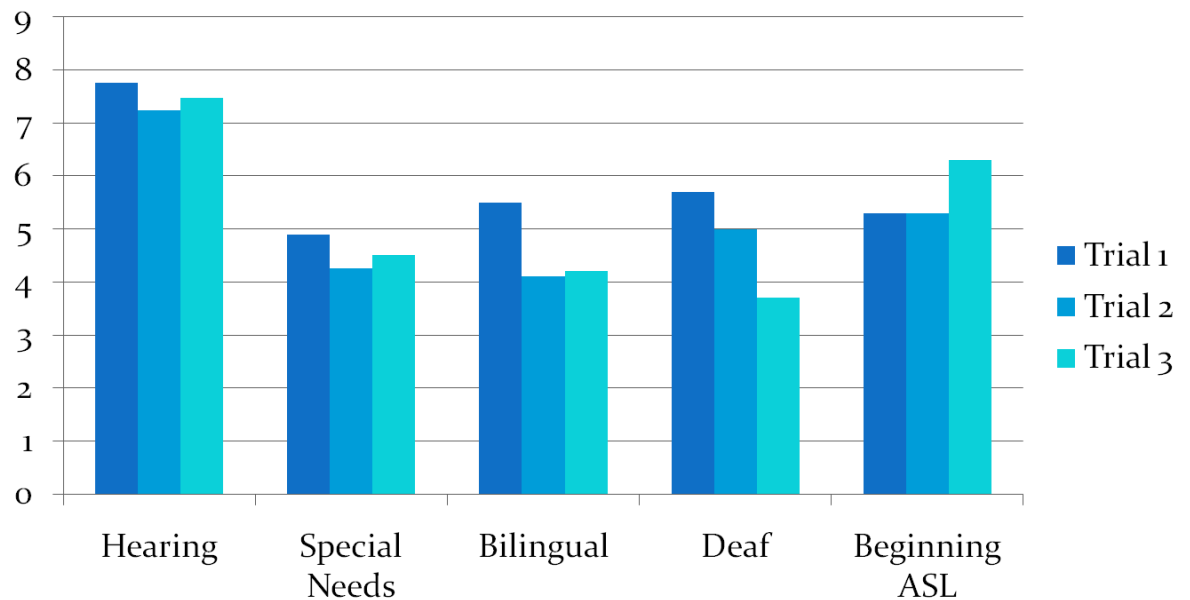
ASL Word Recall: Beginning ASL n = 3

Summary Statistics	Trial 1	Trial 2	Trial 3
Number	3	3	3
Mean	5.3	5.3	6.3
Standard Deviation	1.25	0.47	1.25
Minimum	4	5	5
First Quartile	4	5	5
Median	5	5	6
Third Quartile	7	6	8
Maximum	7	6	8

Trial 1	Trial 2	Trial 3	Per Person Average
5	5	6	5.3
7	5	8	6.7
4	6	5	5
Average	Average	Average	
5.3	5.3	6.3	

The average score among the three ASL tested groups were fairly similar and surprisingly alike to those of the special needs written word recall results. All of the results from the initial data collection were determined using a graphing calculator with the statistical and algebraic built in functions.

The following graph illustrates the similar differences between the lowest four scoring groups, and shows the higher average short term memory scores for the hearing group, across all three trials.



From this study I now know my own personal average STM for ASL, taking my special needs into account, should be in the range of 5 ± 1 . Thus, my STM is in an acceptable range.

Data Analysis

After we collected the summary data about each of the five groups we decided to run an ANOVA. An ANOVA is an analysis of variance to determine if there is a true statistical difference between the groups. For the ANOVA we took the average score for all three trials per person. We used the standard alpha equal to 0.05. We have a “one – way ANOVA” based on Short term memory. That

means there is one factor (STM) we are looking at across the 5 groups. The groups were Hearing, Special needs (based on cognitive or memory difficulties), Bilingual (fluent in both ASL and English) Deaf, and Beginning ASL. The Anova Hypothesis was that all five groups were equal.

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

Anova: Single Factor

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Hearing	21	156	7.428571	2.157143
Sp. Needs	8	36	4.5	1.142857
Bilingual	10	47	4.7	0.9
Deaf	6	29	4.833333	1.366667
Beginning	3	17	5.666667	1.333333

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	86.06964	4	21.51741	13.45956	3.4E-07	2.588836
Within Groups	68.74286	43	1.598671			
Total	154.8125	47				

5 group Anova: Statistical Difference

F value= 13.45

F critical = 2.6

Since F value is greater than the test statistic, we reject the null hypothesis.

Meaning, there really is a statistically significant difference in the STM (short term memory) of the five groups.

We then did a follow-up ANOVA among the four groups with similar averages; Special needs, Beginning ASL, Bilingual and Deaf to check for differences in STM recall among these groups.

Hypothesis Anova: All four groups are equal

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$$

Anova: Single Factor

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Sp. Needs	8	36	4.5	1.142857
Bilingual	10	47	4.7	0.9
Deaf	6	29	4.833333	1.366667
Beginning	3	17	5.666667	1.333333

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	3.066667	3	1.022222	0.918403	0.44753	3.027998
Within Groups	25.6	23	1.113043			
Total	28.66667	26				

4 Group Anova: Statistical Difference

F value = 0.918

F critical = 3.03

Since the F value is less than the test statistic, we fail to reject the null hypothesis. Meaning, there is not a statistically significant difference in the STM (short term memory) of these four groups. Any difference is due to random chance. Thus the hearing group exhibited the best overall STM word recall in this trial study.

Discussion

To say the least I was not pleased with the results. How could it be true that Deaf and Bilingual persons had similar short term memory to that of a special needs individual and those who were learning ASL? The results were especially shocking knowing that the majority of the bilingual individuals were interpreters who watched and communicated in ASL several hours out of every day. In fact, some of the bilingual individuals were not only interpreters but also teachers of the language. The same question is begged amongst the Deaf participants. I know at least two of the participants were teachers. In fact I had seen one of them juggle six or more tasks at a time personally. It appeared this test was stacked in favor of the hearing group. This simply wasn't kosher, something was amiss.

I went to my other Honor's Professor Larry Gray who teaches ASL 1 here at AACC. I asked him: what's up with these results? He pointed me in the direction of the 1967 study; *Graphemic, Phonetic, and Associative Factors in the Verbal Behavior of Deaf and Hearing Subjects*, it says when words were paired the Deaf were better able to remember more pairs than hearing subjects. This study explains definitively why the Deaf and bilingual scored similarly to the special needs and beginning ASL groups. It has been taught in ASL 1 class here at AACC that ASL is a conceptual language. If you have only random words (which are what I had in both the written and ASL DVD STM tests) then there is not a concept to understand or make a connection. For this reason it is fair to say ASL and written English do not equate.

Changes for Future Studies

To get an accurate account of STM amongst the five groups would require some changes in the study. I recommend several adjustments should this idea be explored again sometime in the future. For example, consider the following:

- Give conceptual word pictures to remember.
- Have someone verify the ASL signs to prevent any mistakes.
- Explore spatial memory and its role in a signer's STM.
- Compare ages and activity levels.
- Perhaps a Deaf person should develop the signing test.
- Have less distractions or visual noise around when conducting the study.
- Have a grading system for the proficiency of the ASL students.

Conclusion

This short term memory trial study was a success. The results of this project are similar to those found in other cognitive memory research. I not only found out what my personal STM should average, I came to really understand how different ASL is from the English language. That understanding drew me to conclude that ASL may be stored not only in our brain's short term memory, but also perhaps with spatial memory. I believe an excellent use of future studies would be to determine how spatial memory plays a role in determining the STM of ASL users.

Citations

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