The Westminster School NeuroNet Project, 2008-2009

In August 2006, Westminster School began implementing the NeuroNet Classroom Enrichment Program as a part of their lower school curriculum in some classrooms. Dr. Judith Lauter, a neuroscientist whose interest lies in improving brain function for learning, followed the implementation of this program and collaborated with Westminster School during the 2008-2009 school year to gather data from one third-grade class at the beginning and end of the school year.

Two norm-referenced tests were used in this project, the LAC-3 and the Visagraph (see following paragraphs for a detailed explanation of these tests). Norms for these tests show how much progress a typical child would be expected to make over one school year on each test. We compared the outcomes of the Westminster NeuroNet Project students to these test norms, to see if the students doing the NeuroNet Classroom Enrichment Program would in fact make greater than expected progress over the course of the school year on the LAC-3 and the Visagraph tests.

It should be noted here that the skills tested by the LAC-3 and the Visagraph are in no way taught by the NeuroNet Program. The critical concept tested is whether or not we can change the infrastructure of how children learn, not just what they know, by using a program such as NeuroNet to enhance a child's ability to access and integrate the different specialized functions of the two hemispheres of the brain.

Background information on assessments used in the NeuroNet project

Lindamood Auditory Conceptualization test, 3rd edition (LAC-3)

The LAC-3 evaluates two basic brain skills that are related to understanding speech and are thus important for many activities in the classroom and everyday life, such as gaining information either through reading or listening to verbal instructions.

(1) The first skill is **phonemic awareness.** Phonemic awareness is the ability to identify and manipulate individual speech sounds, called phonemes, when they are *inside syllables* – for instance, to hear that the word "dog" is a combination of three separate phonemes (d-o-g). The only difference among many words in English depends on substituting just one phoneme within a word (and many words differ by more than one). For instance, the word "dog" differs from three other English words based on only one phoneme in each case – either the first (e.g., dog vs. bog), the middle one (e.g., dog vs. dig), or the last one (e.g., dog vs. dawn).

Although for many people, phonemic awareness is very easy, this is not true for everyone. In fact, *approximately 1/3 of all humans do not have fully developed phonemic awareness, at any age*. A number this large suggests that undeveloped

phonemic awareness is NOT a disorder, but is rather simply a normal part of human variety.

The problem is that in a society such as ours, which places such an emphasis on being able to read and listen to speech quickly and accurately, undeveloped phonemic awareness can represent a significant handicap for progressing in school and succeeding in the workplace.

Some researchers believe that phonemic awareness is supported primarily by the *left side of the brain*. Thus an assessment of phonemic awareness may indicate how much access a student has to additional skills from the left side, including other speech and language abilities, abstract reasoning, and fine motor control (needed for clear handwriting, crisp speech production, etc.)

(2) The second skill assessed by the LAC-3 is **syllable perception.** This refers to being able to count how many syllables are in a word, and also to tell their order. In English, syllable perception is related to being able to hear accent, which is used to tell some words apart – for instance, "dessert" (a sweet treat after a meal) vs. "desert" (a dry place). Many people cannot hear such differences between words, and that can lead to problems in understanding.

Accent based on syllables is also important for hearing the difference between a statement and a question, and for analyzing the emotional nature of speech – whether someone is telling a joke, being sarcastic, or indicating they are happy or sad.

Some researchers believe that syllable perception is supported primarily by the *right side of the brain,* and thus an assessment of syllable perception may indicate how much access a student has to additional skills from the right side, including mental imagery (important for reading and listening comprehension as well as arithmetic), social intelligence, and gross motor control (good balance, expressive vocal melody, etc.).

(3) A third and more general capability assessed by the LAC-3 is the ability to do *both these skills at the same time,* which depends on using the two sides of the brain in a coordinated way. Some students who have difficulty working with just one side of the brain at a time (that is, when tested on just phonemes or just syllables) actually have an easier time doing both things at the same time, while for others, the combined task is harder than either one alone. Results on this part of the LAC-3 give us even more information about how the brain is working for that child, and how that might translate into the classroom and everyday life.

All the skills assessed by the LAC-3 can be improved, and at any age, by special training programs, as will be discussed in the last section of this overview.

<u>Visagraph (computer-based test of eye-movement coordination)</u>

The Visagraph is used to evaluate how well the right and left eyes move together. Eye-movement coordination is extremely important for reading. In order to

read quickly and easily, the two eyes must move smoothly together along the lines of print, like two dancers that copy each other's movements almost exactly.

Children and adults whose eyes are not coordinated often have headaches when they read, even if visual acuity is normal. They may also report that the letters on a page "move around" when they are reading, or even "slide off" the edge of the page.

Of course, the letters are not actually moving, but in this case the brain is receiving such mixed signals from the uncoordinated eyes, it cannot tell what is happening. In some children and adults, problems with eye-movement coordination are the only thing that stands between them and being a good reader, and as we will note below, there are effective programs for improving this important skill.

Eye-movement coordination is usually not fully developed until around 4th grade, because it depends on a certain area of the brain that takes that long to become fully mature. Still, many older children and even adults continue to have difficulties coordinating the two eyes, perhaps because of incomplete access to that part of the brain.

Some researchers believe that eye-movement coordination is yet another skill supported by the *right side of the brain*. As a result, assessment using the Visagraph not only provides specific information about eye movements, but may also reflect quality of access to the right brain in general.

Changes in LAC-3 and Visagraph scores over time

Some children in kindergarten can get very high scores on either the LAC-3 or the Visagraph, while others start at a lower level and go on improving slowly into their early college years. Either of these patterns is completely "normal." Normative values provided with both the LAC-3 and the Visagraph tests can be used to evaluate the amount of change over time in individual children, from grade to grade and sometimes even within the same year.

However, other children stop at one level or another, and on their own, never move beyond it. While in most cases, this also is a completely normal feature of human variety, it can still cause difficulties in a culture such as ours, that demands that everyone have access to all these skills at the highest level.

The hopeful thing is that there are special and very effective programs that can "wake up" different parts of the brain, and improve the way they work, both on their own and together. These programs are not "instructional," like most work in the conventional classroom, but are rather more like athletic training, designed to stimulate and guide the brain into a more effective style of organization and access. Because these programs are brain-based, they can be helpful for improving function for individuals at any age, from kindergarten into senior adulthood.

One set of programs for improving brain access is offered by the Lindamood-Bell Learning Processes (LBLP) clinics found around the U.S. (locations are listed on their website, www.lindamood-bell.com). LBLP programs help students develop in

many areas, such as phonemic awareness, spelling, word attack, syllable perception, mental imagery, reading comprehension, and arithmetic.

For eye-movement coordination, the programs known as Vision Training, offered by developmental optometrists (who specialize in working with children) can create dramatic improvements in reading for many individuals.

Another program for improving brain access in a global and very powerful way is known The NeuroNet Program. NeuroNet was developed by Nancy Rowe, an audiologist who is based in Ft. Lauderdale, Florida (www.neuronetonline.com).

Although NeuroNet does not *directly* address the specific skills tested on the LAC-3 or the Visagraph, we believe that NeuroNet activities *exercise the brain* in such a basic, dramatic, and effective way that they can "wake up" all of these as well as other skills, and as a result, can bring about dramatic improvements in student performance not only in the classroom but also in everyday life.

We also believe that NeuroNet is *good for all brains,* whether they have undeveloped skills in one area or not. For anyone at any age, doing NeuroNet exercises on a regular basis may help the brain develop, improve, and maintain a high level of overall function, and thus make an important contribution to quality of life.

WESTMINSTER SCHOOL PROJECT:
WITHIN-YEAR CHANGES IN SCORES ON THE LINDAMOOD AUDITORY CONCEPTUALIZATION (LAC) TEST AND THE VISAGRAPH IN THIRD-GRADE CHILDREN ENROLLED IN NANCY ROWE'S NEURONET PROGRAM

Submitted by: Judith L. Lauter, PhD (July 2009)

I. GROUP DATA

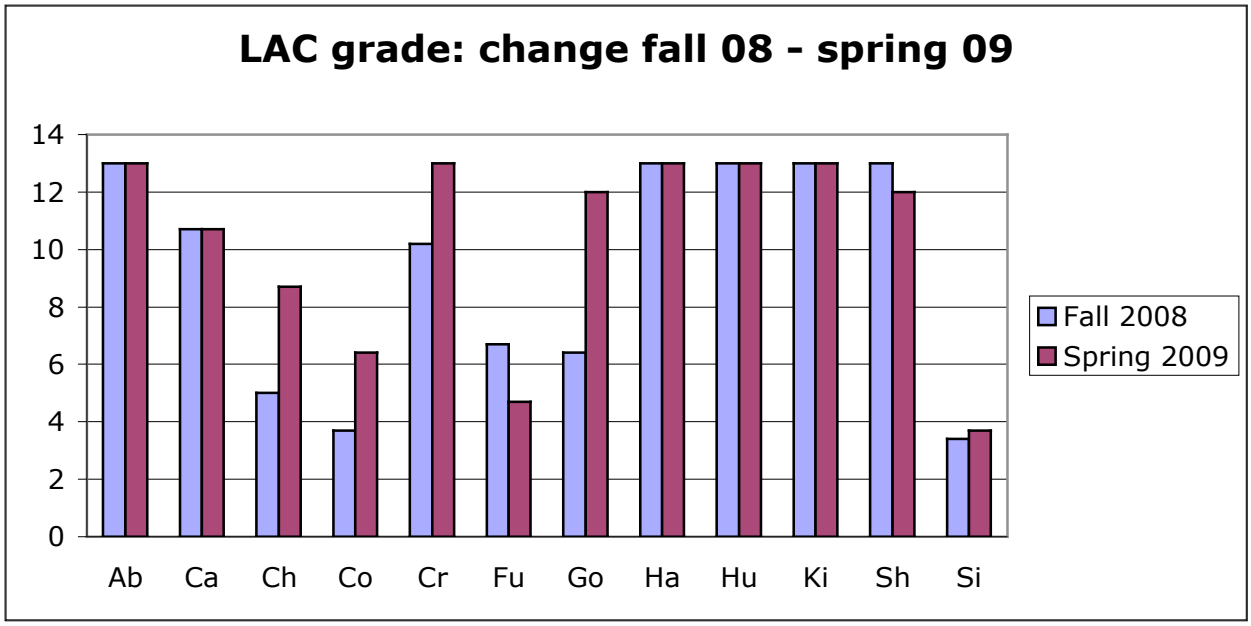


Fig. 1. Change in LAC grade equivalent (according to test norms) from fall [blue bars] to spring [purple bars]. (Each bar is based on the total LAC score, including phonemic awareness, syllables, plus a subtest combining the two.) The graph shows data for only those 12 children for whom interpretable re-test scores were available.
Note that initial scores for *all* of these children were already *above* their current grade level in the fall (that is, above grade 3.0). Five students with initially very high scores did not change further over the course of the year; five others changed their LAC grade by a grade or more (the range was from .3 to 5.6 grades, with a mean of 3 grades); two students (Gr and Mi) showed a slight decline. (Additional notes regarding the two whose scores declined can be found on pp. 5-6 of this report.)

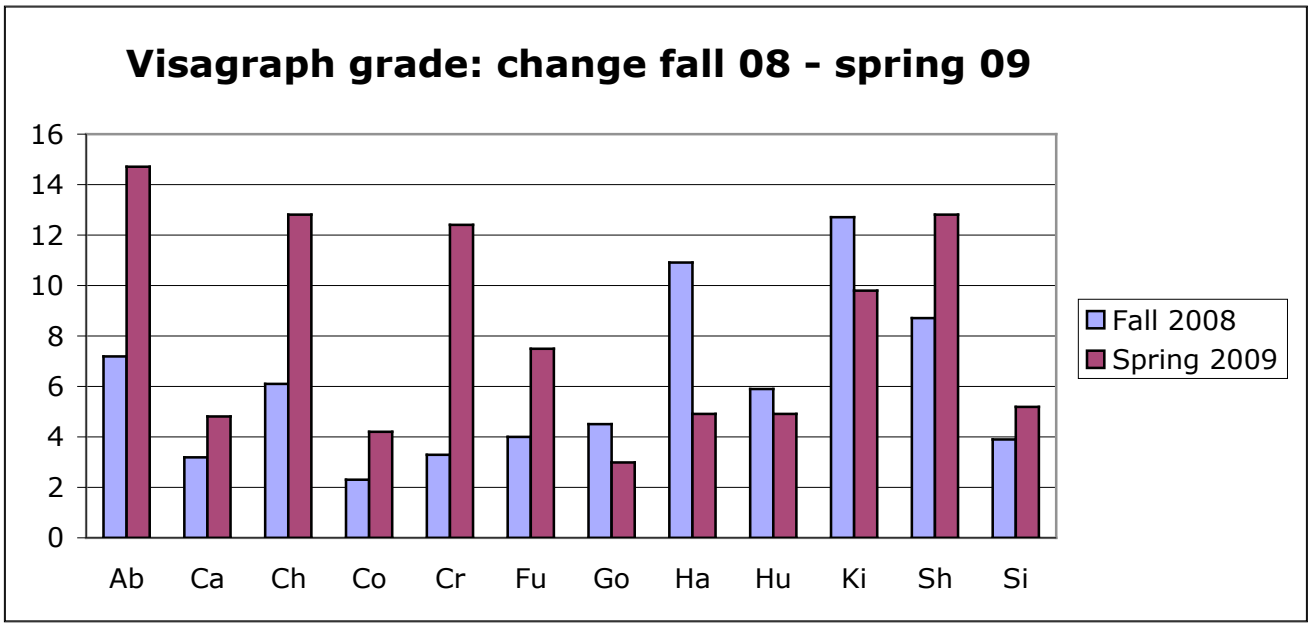
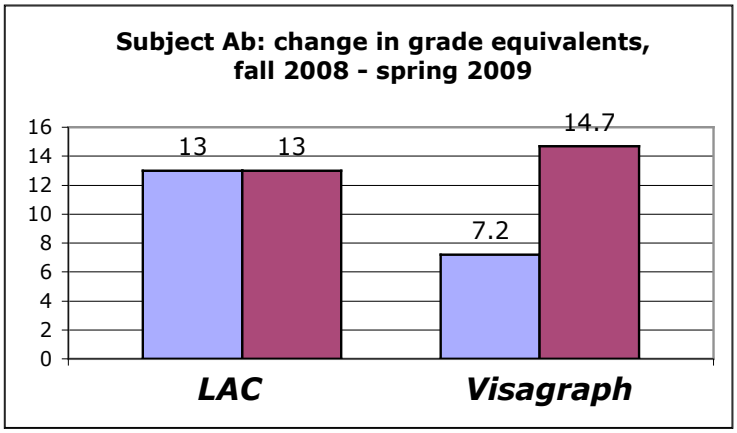
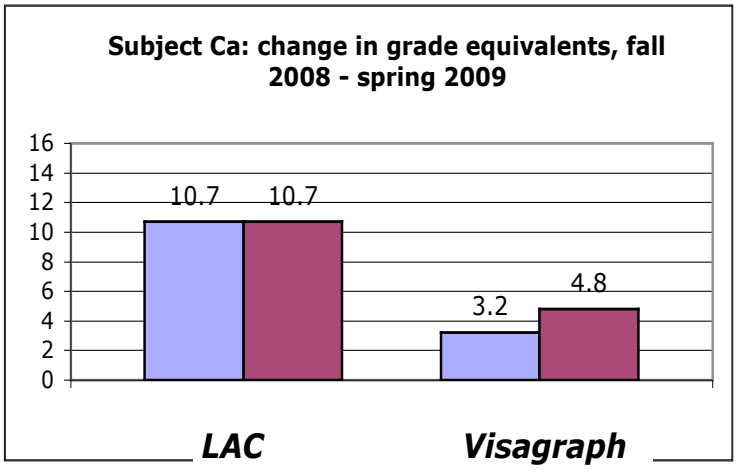


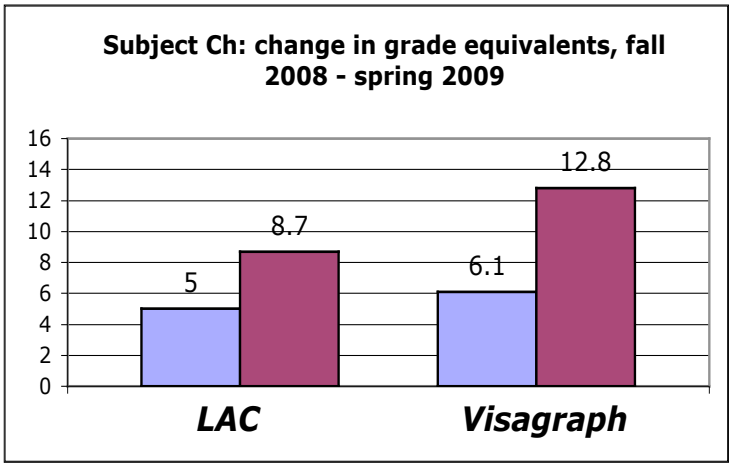
Fig. 2. Change in Visagraph grade equivalent (according to test norms) from fall to spring. Note that eight of the twelve children improved by more than one grade (the range was from 1.3 to 9.1 grades, with a mean of 4.3 grades), while four (Go, Ha, Hu, Ki) showed a decline. (Additional notes regarding the students whose scores declined can be found on pp. 5-6 of this report.)

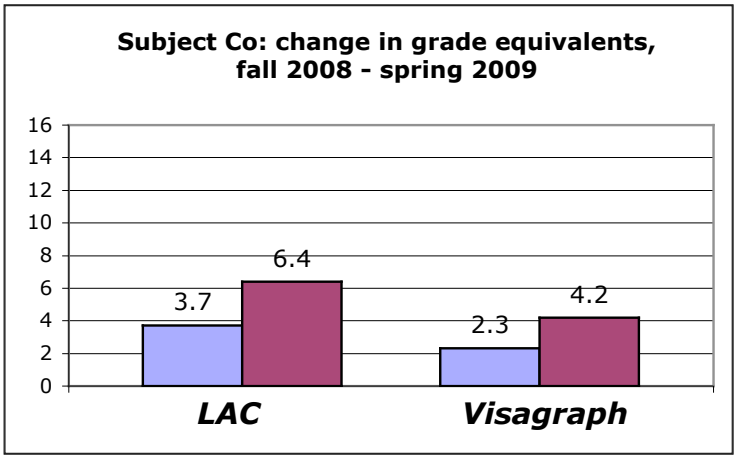
II. INDIVIDUAL STUDENTS

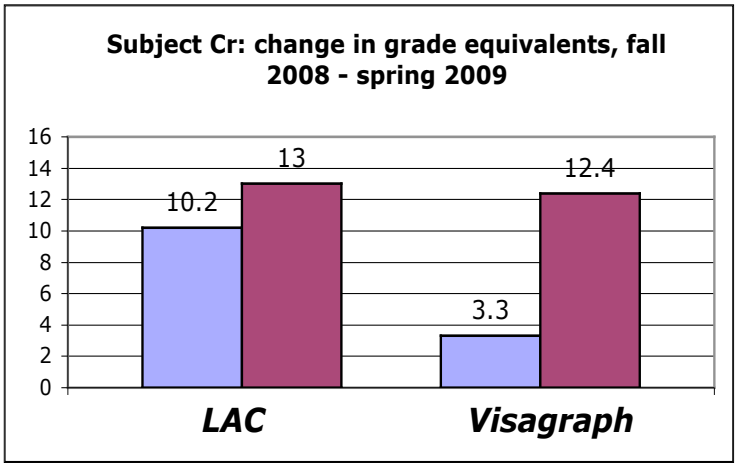
Summary graphs for each child comparing the change in LAC and Visagraph grade equivalents (additional notes on each of the students who showed declines on either test are presented on pp. 5-6 of this report).

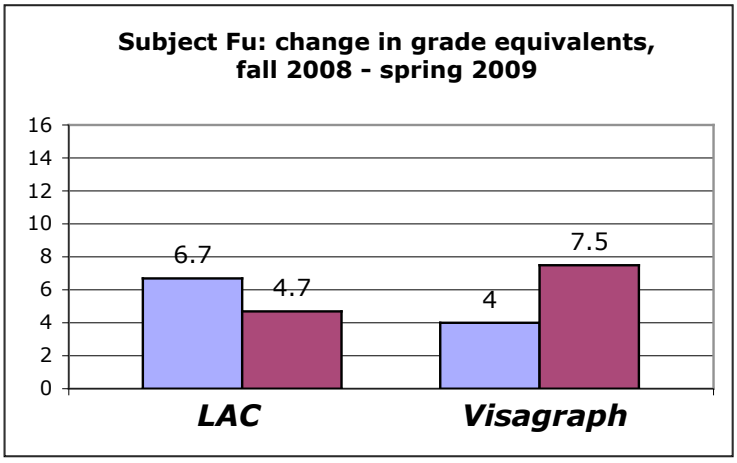


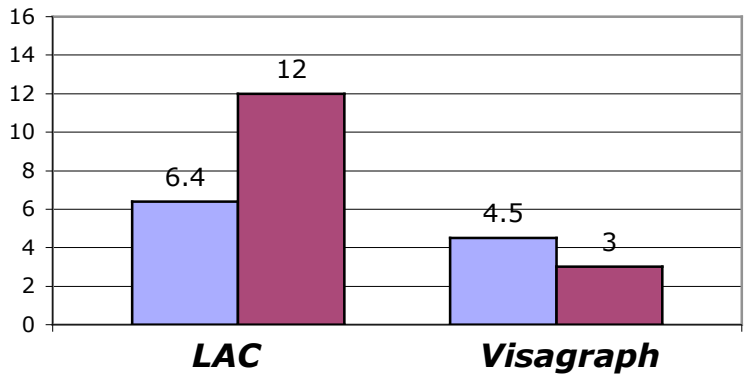


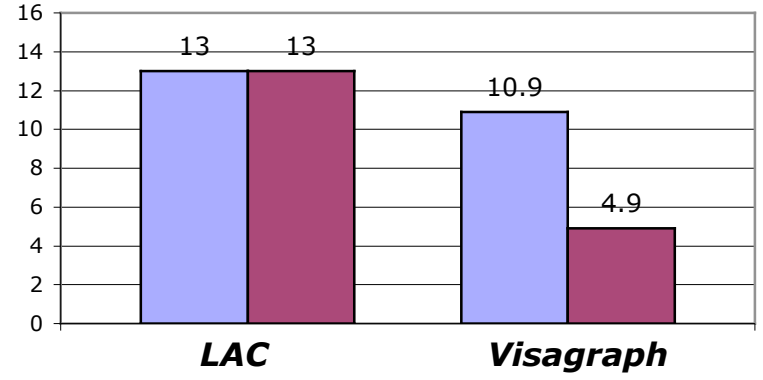


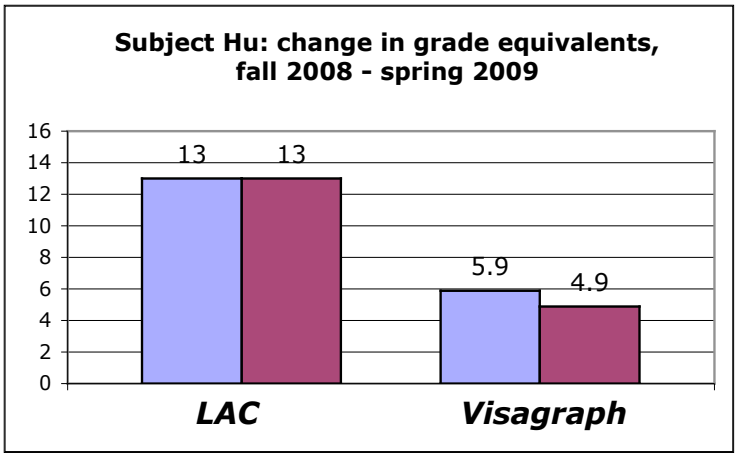







Subject Go: change in grade equivalents, fall 2008 - spring 2009
16
14
12
10
8
6
4
2
0
6.4
12
4.5
3
LAC
Visagraph


Subject Ha: change in grade equivalents, fall 2008 - spring 2009
16
14
12
10
8
6
4
2
0
13
13
10.9
4.9
LAC
Visagraph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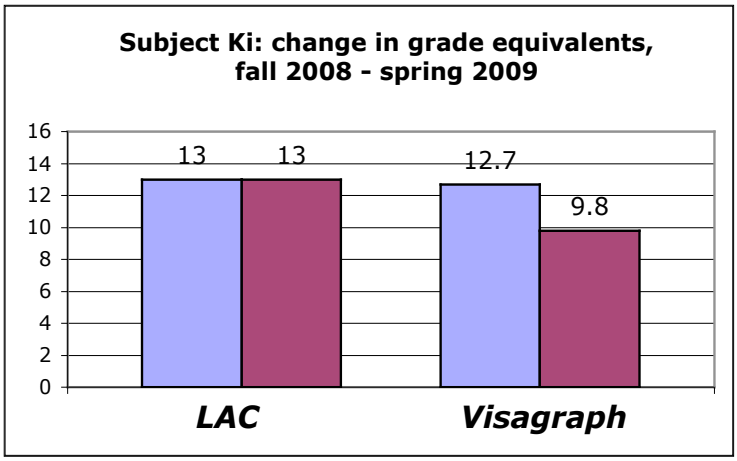
16
14
12
10
8
6
4
2
0
13
13
5.9
4.9
LAC
Visagraph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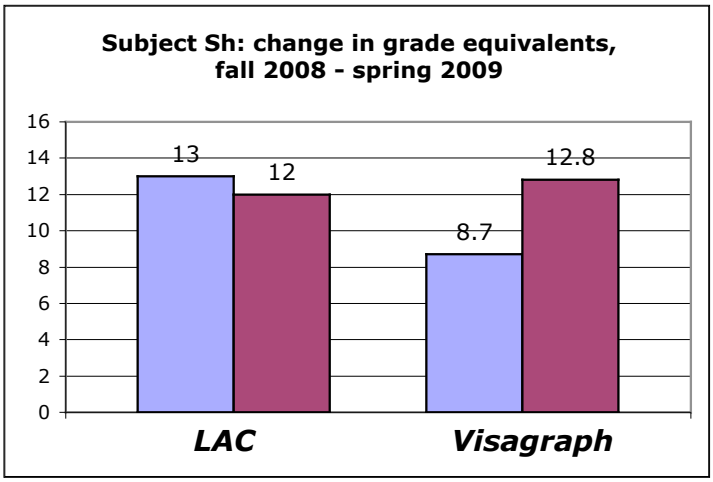
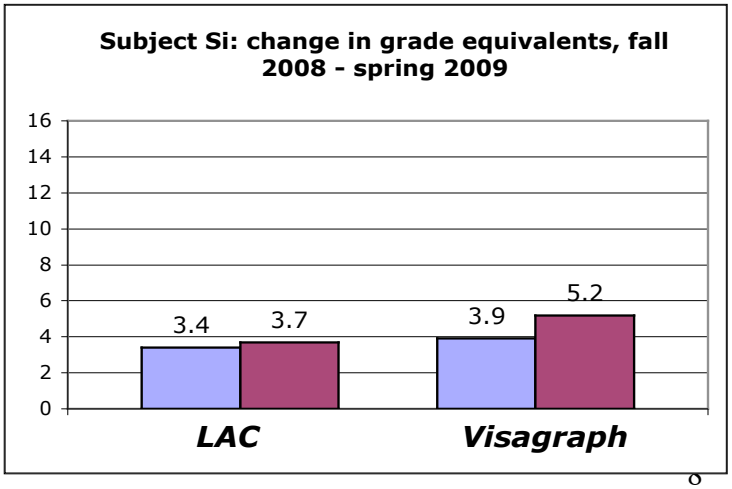
14
12
10
8
6
4
2
0
13
13
12.7
9.8
LAC
Visagraph


Subject Sh: change in grade equivalents, fall 2008 - spring 2009
16
14
12
10
8
6
4
2
0
13
12
8.7
12.8
LAC
Visagraph


Subject Si: change in grade equivalents, fall 2008 - spring 2009
16
14
12
10
8
6
4
2
0
3.4
3.7
3.9
5.2
LAC
Visagraph

Summary list of changes in grade units, alphabetically by student:

Subject	LAC change	Visagraph change
Ab	(stayed at 13th grade)	+7.5 grade units
Ca	(stayed at 10.7th grade)	+1.6 grade units
Ch	+ 3.7 grade units	+ 6.7 grade units
Co	+ 2.7 grade units	+ 1.9 grade units
Cr	+ 2.8 grade units	+ 9.1 grade units
Fu	- 2.0 grade units	+ 3.5 grade units
Go	+ 5.6 grade units	- 1.5 grade units
Ha	(stayed at 13th grade)	- 6.0 grade units
Hu	(stayed at 13th grade)	- 1.0 grade units
Ki	(stayed at 13th grade)	- 2.9 grade units
Sh	- 1.0 grade units	+ 4.1 grade units
Si	+ 0.3 grade units	+ 1.3 grade units

Interpretation of changes:

1. Many children made very impressive gains on both tests, most of them well beyond what would have been expected based on the grade norms for both tests (that is, improvement by more than a single grade unit in a single year). This suggests that NeuroNet may indeed be improving brain function in these children in a way that is over and above simple maturation – although of course, a similar within-year survey needs to be done with a control group of third-graders who are not in the NeuroNet program, in order to put the apparently impressive nature of the changes seen here in perspective.
2. Only two children showed a decline on the LAC test, and their results might be qualified in the following way: a) subject Fu was tested by Dr. Lauter in the fall, but by someone else in the spring, and that difference could have accounted for his change in score – note that Fu did demonstrate an excellent improvement of 3.5 grade units on the Visagraph; b) subject Sh's LAC result remained very high overall, though she went down one grade unit (from 13th grade to 12th grade) from fall to spring; like Fu's result, this small change in an overall very high score could simply be related to re-taking the test rather than a true decline.
3. The largest changes were observed on the Visagraph test, which would be predicted based on Dr. Lauter's belief that NeuroNet more directly activates right-brain (e.g., eye-movement coordination) as compared with left-brain (e.g., phonemic awareness) skills (though she believes its effects may impact many

brain features). However, four children did show a decline on the Visagraph test. It may be important to note that in three of these four (the exception was subject Go) the decline in eye-movement coordination score was associated with a LAC score that was at ceiling (13th grade) on both sessions. Thus this combination of scores suggests that these three children are left-brain types, and they may be experiencing a much more radical right-brain re-organization as a result of working with NeuroNet than the other children in the group. In fact, brain re-organization may also be a factor in the results of the fourth student (subject Go), because along with his small decline in Visagraph score, *he demonstrated the largest improvement in LAC score of the entire group (5.6 grade units)*. It makes physiological sense that a process involving brain re-organization might be associated with a transitory decline in one or more aspects of performance -- a kind of "draw back to leap," resulting in momentary adjustments in ability as the brain re-wires itself and opens up new pathways and connections.

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Lauter, J. 2008. "How is Your Brain Like a Zebra? A New Human Typology." Xlibris.com. Available in hardcover and softcover.
A model for looking at individual differences, and groups of individuals.