NAAVI Subtest Interpretation Guide

For Use with Neuropsychological Assessment of Adults with Visual Impairments (NAAVI)

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For interpretation with purchase of “Neuropsychological Assessment of Adults with Visual Impairment (NAAVI)” (31736)

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Introduction to Guide

This guide is to assist clinicians with administering and interpreting the Neuropsychological Assessment of Adults with Visual Impairments (NAAVI) test. The test is able to assess a wide spectrum of areas of functioning, yielding a great deal of information. The manual accompanying the test contains a great deal of information on how to interpret findings to make inferences about examinee functioning within those areas. This Guide is an attempt to summarize and organize that information for convenience and ease of interpretation.

A suggested use of this Guide is to first refer to the chart of "Areas Assessed by NAAVI Subtests" on the next page. This chart lists different areas of functioning that each subtests assesses. The pages that follow then list information from the manual about the interpretation of each of those areas. So clinicians can read those sections to properly interpret the tests and refer back to the manual in those locations for more information.

This Guide is not meant to supplant use of the Manual. The entire Manual should be read thoroughly before administering the NAAVI. If there are any questions, please contact the publisher Stoelting at the information on the title page.

Areas Assessed by NAAVI Subtests

SUBTEST	AREAS ASSESSED
ADAPTED TOKEN TEST	Receptive Language, Hearing, Understanding directions, Immediate verbal retention
REY AUDITORY VERBAL LEARNING TEST (RAVLT)	List learning, Incidental memory, Episodic memory
TACTUAL FORMBOARD TEST (TFBT)	Spatial exploration, Spatial learning, Independent travel, Spatial distortion, Motor coordination, Sustained attention, Memory-recognition and recall, Spatial understanding, Spatial relations
AUDITORY CANCELLATION TEST	Attention- immediate and sustained, Impulsivity, Response monitoring, Adaptability, ADHD
DIGIT SYMBOL	Spatial learning, Memory, Haptic sense, Processing speed, Learning, Spatial awareness and memory, Spatial orientation
BLOCK DESIGN	Spatial understanding, Tactual-spatial understanding, Spatial rotation understanding, Pattern analysis, Spatial construction
OBJECT ASSEMBLY	Spatial understanding, Spatial construction, Manual dexterity, Assembly skills, Part-to-whole reasoning and construction, Problem solving
PATTERN BOARD	Tactual-spatial memory, Spatial preference, Spatial distortion, Verbal memory, Kinesthetic memory
PATTERN OF SEARCH TEST	Independent travel capability, Executive function, Planning, Thoroughness of spatial exploration, Spatial functioning

Adapted Token Test

Chapter 7
Speech and Language

Verbal Comprehension (Page 30):

The Token Test was established to assess the comprehension of verbal commands that increase in language complexity (De Renzi & Vignolo, 1962). This test, in its various iterations, usually has five sections that require the visual perception of shape and color. Generally, the more complex fifth section has been found to be sufficient for most examinations. Accordingly, a version of Section Five of the Token Test has been adapted for individuals with visual impairment. This version is presented in Appendix I. Basically, it has the individual follow commands of varying grammatical structure, with some extra steps in the last few commands. Ordinarily, neurologically intact adults have little difficulty with this task.

Poor performance, involving three or more errors in the 20 Adapted Token Test commands, might indicate a verbal comprehension deficit. Low scores might also be due to poor attention, receptive aphasia, or impaired working memory. In the version presented here, for adults with visual impairments, the ability to discriminate between the items should be ascertained at the beginning of the test, otherwise tactile discrimination problems might be a source of errors. The items used for this test are usually very easily discriminated by most individuals.

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Testing of Spatial Understanding (Page 42):

The Tactual Formboard Test (see Appendix III) approaches the question of spatial understanding in a variety of ways. First, as mentioned above, the exploration of space can be observed easily, and the measure of time to last row is a numeric representation of part of this process. During this process, it can also be observed whether the individual attempts to understand the shape involved, and to match it to the same shape receptacle. This sounds straightforward, but some individuals simply use a trial-and-error method, moving the piece around the board, hoping it will go in. When the individual finds the intended receptacle for the piece, it can be observed how well the individual is able to rotate the piece in space, and understand this orientation in space, in order to get the piece in the slot. It should be noted that it is possible for the individual to rotate the piece in space, without sufficiently understanding what is going on. For example, turning the circular piece around and round to fit it into the wrong slot seems to suggest a poor understanding of how a circular piece and a circular slot would fit together. Improvement of speed on this task, between trials and within trials, can be taken as learning. For example, learning the layout of the board, and demonstrating an increased understanding of the spatial relationships involved indicates learning is occurring. There are five trials to the Tactual Formboard Test. After the third and fourth trials using both hands, memory for the shapes and their locations are tested. If the individual cannot name a shape, he or she is asked to describe the shape or draw it in the air. The mapping and understanding of the shapes soon becomes evident.

The fifth trial, the rotated trial, is very directly related to understanding space. The memory for shape and location, after the fourth trial, should give a good idea as to how well the subject has made a mental map of the shapes and their locations. On the fifth trial, the board is rotated 90 degrees, with the subject’s hands on the board, so that the nature of the rotation can be understood before beginning the trial. Then, it can be seen whether an individual can rotate a mental map, if one was made, in order to approach this task. It is common to observe the individual struggle with the first two, three, or four pieces but then seem to catch on. Observing their movements, it usually becomes clear if they are using the mental map they made in a rotated way. Presumably, this will translate to how well an individual can understand a building, of which he or she has made a mental map, after coming in a door on one side of the building, then coming in a different door on another side of the building. Is he or she still able to use the map he or she has made?

Hollins and Kelly (1988) attempt to assess knowledge of a layout from a different angle, They have individuals learn a layout of objects on a circular table, and then see if they point out the objects from a different side of the table. This seems straightforward, but the use of a pointer raises the question of whether the subject understood the line it was pointing in.

The Tactual Formboard Test appears to be especially important for the individual who has a compromised sense of space for one reason or another. It is common to see individuals with brain injuries, particularly to the parietal lobe, have a great deal of difficulty with this task. With these individuals, the importance of having five trials and two memory phases becomes apparent. An individual who starts out getting only three or four shapes in the board in the eight-minute time limit, for example, and then continues to have poor performance and poor memory of shapes and location, is likely to do very poorly in spatial-oriented tasks such as mobility/travel and cooking in the kitchen. This assessment provides normative scoring for a measures of how well an individual is able to adjust to the space around them (Adjustment to Space), to what degree they explore their surroundings (Exploration of Space), and spatial memory (Spatial Memory). The procedures for obtaining these scores in described in Appendix III.

Poor performance on location recall, combined with poor performance on the Thoroughness portion of the Pattern of Search, predicts those who will not likely be independent travelers (See Appendices III and VII). However, some individuals with similar brain injuries, who start out just as poorly but are able to show improvement, especially in the later trials and on the memory and location portions of the test, will receive different rehabilitation recommendations. For the first individuals, the likelihood that they would ever be independent travelers is slim, and training should take that into account. For the second group of individuals, even though they are having difficulty in their travel training, the teacher should be encouraged to continue, as they have shown improvement in spatial understanding with enough exposure.

Appendix I (Page 121):

The Token Test (DeRenzi & Vignolo, 1962) has found use in neuropsychological batteries as a test of receptive language and immediate retention. This test commonly uses tokens of different sizes and colors, and has five different sections of directions for the subject to follow. Some studies have suggested that the fifth section of the Token Test was as effective in screening for receptive language problems as the entire test (Strauss et al., 2006).
A review found no adaptation of this test for those with visual impairments.

An early adaptation of this test, for the visually impaired, was attempted by using large spoons, small spoons, large forks, small forks, large plates, small plates, large cups, and small cups. This attempt was eventually abandoned for a more portable, simple system involving large block, small block, large circle or disk, small circle or disk, large tube or cylinder, and small tube or cylinder. The instructions were roughly adapted from the Part V of the Token Test, with the final three items containing the additional element of multiple-step procedures. As with the original Token Test, language is varied and the instructions are only given to the subject one time. The original Token Test Part-V involved 22 instructions; the Adapted Token Test has 20 items.

Interpretation (Page 122):

This test, as adapted, allows the examiner to judge not only the possible presence of receptive aphasia, but also how well an individual can follow directions in general. These would be directions varying in grammatical complexity, and varying in number of steps. Therefore, this is useful not only in neuropsychological assessments but also vocational assessments. An individual of average intelligence, and without comprehension or receptive difficulties, should be able to miss no more than one or two of these directions. Normative data for a nonclinical group is needed to examine the foregoing assumptions.

Rey Auditory Verbal Learning Test (RAVLT)

Chapter 8

Verbal Learning and Memory

List Learning (Page 35):

List learning is a common way to approach verbal learning and memory. Two of the most commonly-used tests are the California Verbal Learning Test (CVLT and CVLT-II) by Delis, et al. (1987, 2000) and the Rey Auditory Verbal Learning Test (RAVLT) reviewed by Schmidt (1996) and Strauss et al. (2006). Evaluations at the Training Center originally used the CVLT, but too many people in this population were unfamiliar with some of the names of fish and spices (a problem corrected on the CVLT-II). The RAVLT's learning lists use very common words without the categorized groupings found on the CVLT and CVLT-II. The simpler, straightforward rote memory aspect of the RAVLT could be considered an advantage in some situations, where assessing memory without enhancement due to abstraction is desired.
The Hopkins Verbal Learning Test-Revised (Brandt and Benedict, 2001) has been used, on occasion, with elderly people with visual impairments. This test is much shorter and does not have an interference list. In the latest revision, a delayed-recall procedure is used.

The RAVLT's learning list has 15 words to be learned over five trials, and then another 15-word interference list, followed by recall of the initial learning list. Later, after a half hour or so, the delayed recall of the learning list, is then followed by a recognition format. The version of the RAVLT presented in this book has expanded this test to include a delayed-memory phase for the interference list, and an incidental memory measure, to compare to the initial recall after the first exposure to the learning list. This version also has a method developed for looking at the recognition format that compensates for false memories, and gets at source memory, a type of episodic memory that is contained within the RAVLT. In addition, this book provides methods and normative scores for assessing delayed memory, learning and accuracy in memory (See Appendix II for details of administration and scoring.) The RAVLT has been the preferred list learning test in this setting. There are normative data and alternate forms available (Schmidt, 1996; Strauss et. al., 2006). Data collected on visually impaired subjects are presented in Appendix II.

Incidental Memory

Returning to the incidental supplement to the RAVLT, incidental memory is a type of automatic memory, where information is encoded into memory simply by being exposed to it, without conscious effort to encode it. Incidental memory limitations are not necessarily signs of neuropathology, but it does appear to happen more often among the neurologically involved than the general population. The method of assessing incidental verbal memory, used here, is to ascertain how many words an individual remembers from the Vocabulary list after completing the test (see Appendix II). The number of words recalled, without being forewarned, from the Vocabulary test, is a measure of verbal incidental memory. This can be compared to the recall of the words from the RAVLT learning list's first exposure (labeled A1 in Appendix II) when the individual is presumably attempting to learn the list. More than a two-word recall difference in favor of list A1 would suggest some level of incidental verbal memory limitation.

It is important, in analyzing the results of the verbal tests, to indicate what strategies appear to be helpful for the individual to learn verbal information. For example, does repetition help? Does chunking help? Does the person need an error-free learning approach? Does visualization help? Does association help? Does meaningfulness of the information help? If the individual is tested a few hours later, for free recall of the RAVLT lists, or even a week later, not much loss is expected; perhaps one or two, over the weeks' time (Geffen et. al., 1997); and one, at the most, over several hours. If the forgetting rate is more than this, then learning booster sessions should also be recommended, so the individual does not lose what is learned over time as easily.

Episodic Memory

Amnesia (Page 35):

Retrograde amnesia refers to the lack of ability to recall events leading up to the injury. This retrograde amnesia may be of varying durations. Sometimes, it gets more compacted or shortened in duration, moving back towards the injury over time. Presumably, the ability to consolidate memories has been disrupted, and the memories, even though initially encoded, are lost. Learning disruption after the injury is post-traumatic amnesia. Post-traumatic amnesia (PTA) refers to the inability to track events after the injury, and this can also be of varying durations. The length of time after an individual is conscious, without being able to encode memories of events, is quite understandably related to how severe ultimate cognitive disabilities will be (Levin et al., 1992). Therefore, in dealing with the head injured individual, the length of retrograde amnesia and post-traumatic amnesia is of equal or greater importance, than the length of coma. Anterograde amnesia refers to problems encoding, and recalling new memories after the injury, and can extend well beyond the period of post-traumatic amnesia.

The chapter on Verbal Memory and Appendix II detail information on the Rey Auditory Verbal Learning Test (RAVLT). This is a test of learning facts, or semantic memory: but there is an episodic-memory measure on this test related to source memory. That is, during the recognition phase, when words are identified as to whether they were on the first list, the second list, or neither list, source errors can occur. The S score derived from this test relates to how many source memory errors there are. These will be errors where the first-list words are identified as being from the second list, and the second-list words are identified as being from the first list. Generally, intact individuals have few, if any, source memory errors. Individuals with episodic memory problems will

generally have three or more source memory errors (see Appendix II).

Appendix II

(Page 124):

Since it was first introduced in 1941 by Rey, the Rey Auditory Verbal Learning Test (RAVLT) has been a common word-list learning test. It has been translated into many languages. The version used here is the usual English translation version with Lezak's recognition format (Lezak, 1976; Strauss et al., 2006), but with some additional modifications for administration and scoring.
The data presented here were gathered on a visually impaired population from all over the State of Michigan. The RAVLT was chosen for this population, over the California Verbal Learning Test, as the words in the California Test proved unfamiliar to many of the subjects. Additionally, the unrelated words on the RAVLT were seen as an advantage, allowing for more direct comparison with Vocabulary recall, and getting at memory unenhanced by category groupings.

The RAVLT is a list-learning test comprised of an initial learning list of 15 unrelated words, and an interference list of 15 unrelated words. The learning list (List A) is presented in total for five trials, where the subject immediately recalls the list after each trial. The interference list is then presented, with an immediate recall for that list. Following this, without hearing the first list again, the subject is asked to recall the first list only. One half hour later, the subject is again asked to recall the first list, from memory. After this, there is a free recall for the second list. This delayed recall for the second list (List B), was not found to be advocated, or researched, in a review of the literature. Following this, Lezak's recognition items are read to the individual who labels each word as from the first list, the second list, or a new word from neither list.

Modifications presented here to the RAVLT are the recall for List B, listed in the previous paragraph, and a new scoring method for the recognition procedure. Additionally, the Wechsler Vocabulary subtest is administered sometime after the RAVLT is completed. At the conclusion of the Wechsler Vocabulary subtest, the individual is asked to recall, without forewarning, the words from that vocabulary list. This is done so that comparison can be made to the recall for the RAVLT words after the first trial

(A1) for the learning list. The idea here is that recall for the Vocabulary List is an incidental, verbal memory measure, as opposed to intentional learning recall for the first hearing of the RAVLT list. Incidental memory is that type of automatic learning where memories are registered, without conscious attempt to remember the information. The format of the Vocabulary Test makes it reasonably certain that the individual attended to the words on the Vocabulary List. This method is used only if 15 or more words on the Vocabulary Test were actually administered. The modifications to the recognition format were made to account for a couple of factors. The first is that existing recognition memory scores either do not account for false positive memories, or they are presented as complicated indexes. Recognition memory is usually not recorded for List B, but this has been done. The method used here is easy to calculate and appears to make some intuitive sense. That is, the number of false positive responses for each list are subtracted from the correct recognitions, on the idea that an equal number of correct recognitions may therefore be random recognitions, rather than the subject truly recognizing them. The second modification of the scoring for recognition involves scoring for source memory problem. This has only been occasionally done by previous authors. Source memory errors involve labeling words from the first list (A) as being from the second list (B) and labeling words from B as being from A. Using these modifications, there are some totals scores that can be calculated to get a more accurate idea of the effectiveness of recognition memory, by compensating for false memories and source memory errors.

The test record form is shown in Figure II.1. A sample scored record form is shown in Figure II.2.
It might also be noted that the commonly-used measure of total words recalled for the learning list, from trial one to trial five, is not used here. Although this has been called the most psychometrically-sound measure, it does not really differ that much from looking at recall for list five alone. Using recall for trial one (A1) compared to trial five (A5), can give information about the learning curve. Of course, the protocol itself can be looked at, to see progress through trials one through five, and how well this is maintained to A6 and A7. The forgetting rate from A5 to A7 can be compared to the forgetting rate from B1 to B2.

Interpretation (Page 128):

The RAVLT is purposely a test of unrelated words. Although most individuals attempt to recall these simply by rote, others may use some type of mnemonic device to assist their recall. They may use visualization; they might use some sort of meaningful connection with the words; they might use classical mnemonic devices such as memory palace; they might use chunking; and so on. This may become obvious during recall if the individual says something like, **"Let's see, the farmer was looking at the moon while feeding his turkey, so that is farmer, moon, and turkey."** Otherwise, the examiner may wish to ask the person at the completion of testing if they used special ways of remembering the words.

Another score that can be calculated is: A1-Vocabulary Recall (VR), which is recorded (A1-VR = D) as a difference score. Trial A-1 minus Vocabulary Recall (VR) gives an idea of the strength of incidental learning, versus effortful learning. People with A-1 greater than 4 points more than Vocabulary Recall would be poor at verbal incidental learning. There was not a significant difference in this relative incidental value between the neurologically-involved, visually impaired (Neuro) and the remaining visually impaired sample (OVI). Neuro mean for A1-VR=2.1; OVI mean for A1-VR=2.6. There was a significant difference between these two groups in the mean performance for each metric (A1, VR).
It appears that this difference measure of incidental memory is relatively consistent across groups. There will be some persons who will recall a greater number of Vocabulary words than words from A1. These individuals likely have enhanced their verbal memory by the extra time taken with each word, and by attaching meaning to each word.

Discovering what enhances the individual's memory can be more important than comparing the results to the normative data. For example, by comparing B2 to A7, this can partially answer the question as to whether repetition helps the individual's memory. If free recall is substantially lower than recognition recall, a weakness in retrieval might be inferred. If there is a substantial difference between the erroneous false positives for the repeated list, as compared to the non-repeated list, this is important to note. Did the individual appear to be overwhelmed by the amount of information on the list? This might be suggested by recall of the first items on the list and none farther down the list. Did memory encoding seem to be a problem? This might be suggested by recall of the last few items of the list, without any before that. Is there a significant number of source-memory errors? This may indicate problems with other types of time indexed, episodic memory, as well. Should the individual's performance fall off in the last two learning trials, rather than remain the same or continue to improve, this may mean a lack of persistence, or some level of emotional interference by frustration or anxiety.

Tactual Formboard Test

Chapter 11
Spatial Ability

Exploration (Page 42):

Some tests, such as the Purdue Pegboard and Digit Symbol, require the examiner to orient the individual to the test materials, even guiding the individual's hands to the appropriate parts of the test while explaining the parts of the test, and the procedure. With other tests, such as Object Assembly and Tactual Formboard, the subject is left to do exploration on his or her own, and this can be observed. It might be noted that with the Tactual Formboard, the time to last row is taken as a formal measure of exploration (see Appendix III). That is, it is advantageous for the individual who is introduced to this test to feel the entire board in order to know what he or she is dealing with. Surprisingly, this is rarer than would be thought. Individuals, even without neurologic damage, will take an excessive amount of time before exploring the part of the Tactual Formboard that is farthest away from them. Some individuals seem to naturally explore space. These are the individuals who will ask the examiner about the room, and other questions to orient them in space and to understand the space they are in.

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Testing of Spatial Understanding (Page 42):

The Tactual Formboard Test (see Appendix III) approaches the question of spatial understanding in a variety of ways. First, as mentioned above, the exploration of space can be observed easily, and the measure of time to last row is a numeric representation of part of this process. During this process, it can also be observed whether the individual attempts to understand the shape involved, and to match it to the same shape receptacle. This sounds straightforward, but some individuals simply use a trial-and-error method, moving the piece around the board, hoping it will go in. When the individual finds the intended receptacle for the piece, it can be observed how well the individual is able to rotate the piece in space, and understand this orientation in space, in order to get the piece in the slot. It should be noted that it is possible for the individual to rotate the piece in space, without sufficiently understanding what is going on. For example, turning the circular piece around and round to fit it into the wrong slot seems to suggest a poor understanding of how a circular piece and a circular slot would fit together. Improvement of speed on this task, between trials and within trials, can be taken as learning. For example, learning the layout of the board, and demonstrating an increased understanding of the spatial relationships involved indicates learning is occurring. There are five trials to the Tactual Formboard Test. After the third and fourth trials using both hands, memory for the shapes and their locations are tested. If the individual cannot name a shape, he or she is asked to describe the shape or draw it in the air. The mapping and understanding of the shapes soon becomes evident.

The fifth trial, the rotated trial, is very directly related to understanding space. The memory for shape and location, after the fourth trial, should give a good idea as to how well the subject has made a mental map of the shapes and their locations. On the fifth trial, the board is rotated 90 degrees, with the subject’s hands on the board, so that the nature of the rotation can be understood before beginning the trial. Then, it can be seen whether an individual can rotate a mental map, if one was made, in order to approach this task. It is common to observe the individual struggle with the first two, three, or four pieces but then seem to catch on. Observing their movements, it usually becomes clear if they are using the mental map they made in a rotated way. Presumably, this will translate to how well an individual can understand a building, of which he or she has made a mental map, after coming in a door on one side of the building, then coming in a different door on another side of the building. Is he or she still able to use the map he or she has made?

Hollins and Kelly (1988) attempt to assess knowledge of a layout from a different angle, They have individuals learn a layout of objects on a circular table, and then see if they point out the objects from a different side of the table. This seems straightforward, but the use of a pointer raises the question of whether the subject understood the line it was pointing in.

The Tactual Formboard Test appears to be especially important for the individual who has a compromised sense of space for one reason or another. It is common to see individuals with brain injuries, particularly to the parietal lobe, have a great deal of difficulty with this task. With these individuals, the importance of having five trials and two memory phases becomes apparent. An individual who starts out getting only three or four shapes in the board in the eight-minute time limit, for example, and then continues to have poor performance and poor memory of shapes and location, is likely to do very poorly in spatial-oriented tasks such as mobility/travel and cooking in the kitchen. This assessment provides normative scoring for a measures of how well an individual is able to adjust to the space around them (Adjustment to Space), to what degree they explore their surroundings (Exploration of Space), and spatial memory (Spatial Memory). The procedures for obtaining these scores in described in Appendix III.

Poor performance on location recall, combined with poor performance on the Thoroughness portion of the Pattern of Search, predicts those who will not likely be independent travelers (See Appendices III and VII). However, some individuals with similar brain injuries, who start out just as poorly but are able to show improvement, especially in the later trials and on the memory and location portions of the test, will receive different rehabilitation recommendations. For the first individuals, the likelihood that they would ever be independent travelers is slim, and training should take that into account. For the second group of individuals, even though they are having difficulty in their travel training, the teacher should be encouraged to continue, as they have shown improvement in spatial understanding with enough exposure.

Chapter 12
Spatial Learning and Memory

(Page 45):

Spatial learning and memory is roughly equivalent to visual learning and memory for the sighted population. However, memory for movements play a larger role in spatial memory for the person who is visually impaired. That is, observing the subject's movements tells something about a movement memory, or sense of distance and location memory, when this occurs over time. For example, on the Purdue Pegboard Test the individual has to move his or her right and left hand to find the well that has the pegs in it. On the assembly portion of the test, there is more to remember in that there is a well for pegs, for sleeves and for collars. Depending on how the person approaches the test, there may be memory for where the next hole is, to put the assembly. That is, if the person is using a two-handed method, as is encouraged, spatial memory is needed to remember the location of the next hole. With the Tactual Formboard Test, movement/spatial memory can be involved on the single-hand trials.

Tactual Formboard Test

The Tactual Formboard has its own memory trials (see Appendix III). After each trial, using both hands (trials 3 and 4), there is a memory assessment for recognition of the shapes (content) and their locations. Note that memory for the Tactual Formboard is mediated by verbal memory, as well as spatial memory, due to a need to verbally recognize shapes. Should the individual do poorly on the second memory for content and location, that is, less than five memory for content and less than four memory for location points awarded, further assessment could be done. Testing the limits trial could be used, which is not part of the standardized Tactual Formboard Test. That is, the individual could be presented with the completed board, in order to study the shapes and locations, then a memory for content and location trial could be done for a third time. Note that if this procedure is used, comparison of the rotated trial to the normative values would be quite different, as the testing of limits was not included in the norms, before the rotated section was used. However, if location memory is very poor after the second memory trial, the idea of rotating a mental map would not apply, as the map was not established. For this reason, the rotated trial is often left off, as without a mental map, it loses interpretive value.

Mangiameli's Tests (Mangiameli et al., 1999, Mangiameli & Peters, 1999, Mangiameli, 2003) have a version of the Tactual Performance Test that is similar to the Tactual Formboard Test, but has one memory trial for content and location and no rotated trial.

Chapter 13
Spatial Distortion

Instruments to Assess Spatial Distortion (Page 47):

There are other tests that can give information about understanding of spatial areas that are more structured than the Pattern of Search Test. This is particularly true of the Tactual Formboard Test and the Pattern Board Test. The Spatial Pattern Recall and the Haptic Memory Recognition Test may also contribute to this. The Block Design Test from the Haptic Intelligence Scale is not as useful, in this regard, as such a small area is used. Mangiameli (2003) has a test called the Tactual Search Board that is large enough to be able to observe which areas of space are not receiving attention.

The Tactual Formboard Test is a very useful test of spatial distortion, as problems can be seen both in the performance portion of this test, and in the memory portion. During the performance portion of the test, individuals might try to put the shapes in on one side of the board, tending to ignore the other; or will ignore portions of the board such as far right, far left, close center and so forth. During the memory portion of this test, there are no slots to guide the placement of the pieces, and they are placed on the board as the subject remembers them. It can then be seen if the subject crowds the pieces over to one side or another or, quite often, close to the subject. If all the pieces are crowded close to the subject, it represents shrinking of space. Individuals will often confirm they have a conception of space, where they might be leaving a room, and think they have reached the door well before they have. Or, they may search for things, and simply not reach far enough. Individuals who demonstrate shrinking of space, on the test, can also be observed to do this more than others in everyday situations.

The Benton Visual Retention Test (Strauss et al., 2006), for sighted individuals, can be scored for errors on the right, or left, side. The Pattern Board Test might be considered roughly analogous to this, in that it can be observed in the reproductions from memory as to the right and left side; and that there seems to be a predominance of errors on one side or another, to a significant degree. Or, it might happen that the whole remembered pattern is shifted, in some direction, from the original. Such anomalies on one pattern is likely not meaningful. Repeated errors of a consistent type are what are noteworthy.

Spatial distortion is certainly not seen in every visually impaired person, but when it is, it is important to understand. Then, the individual, and the people working with the individual, can compensate for it, based on feedback from the examiner. When individuals are told of their spatial distortions, revealed by the testing, they often recognize on their own how this has been evident in their daily lives.

Clinical Example

A 71-year-old man had no vision in his right peripheral field, due to left-hemisphere occipital, ischemic stroke. His left visual field was intact with adequate acuity. He still did some work on the farm, including driving a pickup. At first, he appeared to neglect his right side, as he would run into a ditch or bump into things, on his right side. With practice, he learned to scan to his right. This gentleman took the Tactual Formboard Test and the Pattern of Search Test, blindfolded. He was slow, but able to complete the Tactual Formboard Test on each trial. He was able to use his right hand. However, for each trial, he tended to explore the right side of the board only after he had filled in most of the left side. The Pattern of Search Test results were more dramatic, and could be interpreted as indicative that there was still a tendency to neglect the right side of his space. He displayed a good search strategy, by searching back and forth across the page with close, parallel lines. However, there were almost no lines made in the right side of the page. Notably, he held his pen in his right hand, to search. It would appear that an underlying spatial neglect of the right side was still present, in spite of his ability to adapt.

Chapter 18
Motor Testing
Coordination (Page 60):

Observations of an individual's coordination with each hand, and bimanual coordination and cooperation can be observed. Use of the hands together can be observed with the Tactual Formboard Test and the Purdue Pegboard Test. The Tactual Formboard Test is also useful in observing movement memory with the single-hand trials. Coordination can be assessed in the usual ways; for example, with fingers to thumb movements, rapid finger touching, and rapid alternating movements (diadochokinesis). A test of rapid alternating movements, commonly used, is having one hand with palm touching the table, while the other hand is a fist touching the table. The individual is instructed to alternate in quick succession. The coordination of these movements can be related to prefrontal motor organization, as well as cerebellar functioning. That is, presuming that the basic motor abilities are intact. When testing for motor abilities, it might be also a good time to slip in a go, no-go task.

Appendix III

Interpretation (Page 140):

It can be seen from the normative tables that the general population of individuals with visual impairments, in Michigan, performed better in all ways on the Tactual Formboard Test as compared to the sample of mixed neurologically-compromised, visually impaired people, and the sample of adults who are born with very low birth weight and visual impairment. So, the question can be brought up as to what specific functions are compromised in the latter two groups. A number of possibilities come to mind.

First of all, it takes a certain amount of sustained attention and persistence to perform well on this task, which can be lengthy, in terms of time, for many. It might be expected that if sustained attention or persistence problems are present, performance would tend to fall off as

time goes on. Individuals doing substantially worse on the second trial with both hands, than on the first would raise the question of poor sustained attention or persistence, or perhaps fatigue. Of course, some individuals might become irritated with the lengthy and repetitive nature of this task and either refuse to continue or start performing poorly. This has happened very infrequently.
The test taker's haptic ability to identify the shapes, and match them to their same shape receptacles, would seem crucial to this task unless the individual was using the trial-and-error approach. During the memory phase, it should become clear as to whether the individual was able to identify shapes during the test. True, an individual might be able to guess at some of the shapes, such as circle, square, and triangle, even if unable to identify them; but this seems to be a very rare occurrence. Should there be some doubt about the individual's ability to identify the shapes, this could be assessed at the end of the test, by laying all the shapes out in front of the individual, and saying, **"Find the star. Find the triangle,"** etc**.** Should more detailed information about the individual's ability to identify shape be needed, the Haptic Sensory Discrimination Test (Dial, Mezger et al., 1991) could be given.

It is quite common to find individuals who appear to understand the shape they pick up and manipulate, but are not able to match it very well to the slot that it goes in. This would indicate that the basic ability to do tactual identification is intact, but is not highly developed. A person of average intelligence, normal tactual sensitivity, and an intact spatial sense should be able to match the shapes with their receptacles without a great deal of trouble. In discriminating what the shapes are, the cross and the star are often confused, and the hexagon is rarely recognized as a hexagon. Should an individual have no difficulty with these three pieces, they would be considered above average in the haptic discrimination of shapes.

The executive function of planning an approach to the task, or strategy, seems essential for a good performance. The measure of how long it takes an individual to explore the last row of the board (the back row of the board farthest away from the subject) seems to offer some information as to a person's ability to develop a strategy to approach the task. Surprisingly, very few individuals in the entire sample explored the board before picking up the first piece. So, if the individual does, this would place that person above average in terms of developing a strategy to approach the task. Also, related to executive function is the ability to adapt and shift. Some individuals can be noted to perseverate on a wrong choice, attempting to get a piece into an erroneous slot without moving on. This perseveration can be taken, as any perseveration is, as possibly symptomatic of neurologic impairment. Other inabilities to shift, such as the inability to change strategy if one did not seem to be working,, are not as diagnostic and may relate to psychological, rather than neurologic, factors.

A major reason for developing this test is to assess spatial understanding and spatial learning and memory. Spatial understanding can be shown in several ways. The individual typically has to rotate the piece in space in order to fit it into the slot (the circle is an exception here). Some individuals do not seem to understand the need to rotate, or understand rotating in space itself. This appears to be particularly true of the low birth weight individuals. This appears to get at what, in vocational tests, might be called *spatial relations*, or knowledge of how an object moves in space. For some individuals, there may be some imagery involved in doing this type of task. Spatial understanding also extends to the test as a whole. Thus, if the individual is going to do well in comparison to the norms and improve from trial to trial, understanding of the objects, and how they fit into the space of the board, is essential. Of course, knowledge of the space of the board is assessed by the first and second location memory trials. Problems in memory for location can be hypothesized to go along with parietal lobe deficiencies. Individuals with anoxic damage to the brain seem to be hard hit in this area. It should be obvious that learning location in space is invaluable for visually impaired individuals. Location memory scores for the second location trial, below five, would indicate difficulty with this type of understanding and memory for location. Scores below three would indicate marked problems. The individual who cannot improve from trial to trial, being unable to get all 10 pieces in and whose memory for location is profoundly impaired, is likely to be lost in space. These individuals will likely never be independent travelers, other than with precise door-to-door service.

It might be noted here that TFBT memory for location has some similarities to the Pattern Board memory from the Haptic Intelligence Test (Shurrager & Shurrager, 1964) and the Spatial Pattern Recall from the Cognitive Test for the Blind (Dial, Mezger et al., 1991). It can be hypothesized that the Pattern Board would be the easiest of the three tests to use verbal encoding to assist spatial memory, while Spatial Pattern Recall and the Tactual Formboard Test Memory would be harder to verbally encode.

The advantage of the Tactual Formboard over these other tests is that it is a learning process, with repeated trials, rather than a single trial for each memory item on

the Pattern Board and Pattern Recall Tests. This becomes particularly valuable for an individual with impaired performance on the Tactual Formboard Test. A very substandard performance, with no improvement over the five trials and two memory sections, is a much different picture than that of a person giving an initial impaired performance, who gradually improves over time. In other words, results from the TFBT can demonstrate that with repeated exposure and efforts at learning, learning of space is possible for some individuals and much more difficult for others, even if their initial performance was virtually the same.

Interpretation of the Rotated Trial is possible if the memory for Location 2 performance is good enough to discern that the individual has made some mental map of the layout of the board. Then the interpretation is based, not only on the speed, but the observation as to whether the individual appears to be have rotated the map in mind to enhance performance. If the individual simply searches around, with every piece, without attempting to go to a remembered location, then no rotation of a mental map has taken place, no matter how fast the performance. This ability to understand space from different directions is important for functioning in a variety of situations; for example, understanding the layout of the furniture in a room. Is it understood when coming in a different door into the room than usual? Or, the layout of a building; is it understood from one door to another? Or the layout of a city; is it understood from one street to another? Taken as a whole, individuals who do well on the Tactual Formboard

Test will do well in classes, such as travel training and kitchen skills. The opposite also appears to be true for those who do poorly on the test. These individuals are likely to do poorly in these areas.

One feature that can be observed during the Memory and Location trials is how the individual groups the pieces on the board that are recalled. There seem to be natural individual variations as to how much an individual will shrink space in this endeavor. Observation and questioning of individuals who tend to group the items close to them, disregarding the farther reaches of the board, reveals that they do tend to shrink space in other contexts. For example, after being in a room, if the individual turns around and wants to leave by the same door, the individual will think they are at the door well before they are; thus, shrinking space. This is not necessarily a hallmark of a neurologic problem, but rather seems to be an individual variation among people.

The TFBT has been used for individuals who are losing their sight, and are concerned about how well they will function when they are completely blind. Most individuals, in this situation, will gladly take the test under blindfolded conditions. Their performance on the test can give them some sort of indication of how well they might do in terms of understanding space, and remembering space, once vision is lost. Using the test in this way is typically very appreciated by the person in this situation.

Auditory Cancellation

Chapter 14

Attention

Immediate Attention Span (Page 49):

The current version (Auditory Cancellation Test, Appendix IV) using Mesulam's letter sheet is much longer. Perhaps it is not as statistically robust as the computerized tests, but it contains around four minutes of sustained vigilant attention demand, and a simple kind of portable format, making it a cost-effective and convenient option. Some authors (Meyer & Lange, 2005) have considered the Mesulam Cancellation Test as a continuous performance test, and the same should hold true for the sustained attention Auditory Cancellation Test. The test is scored for omission errors (not responding to a target letter) and commission errors (responding to a non-target letter). It is interpreted to indicate that omission errors relate to attention lapses, and commission errors relate to impulsive responding or poor response monitoring.

Appendix IV

Background:

Strub and Black (1985) have used a short test in their mental status battery that involves the subject giving an indication of when a certain letter is heard. Mangiameli (2003) has a similar auditory version of this. The target letter is imbedded in other letters. Strub and Black's version, and Mangiameli's are brief, and while it might be a reasonable look at span of attention, it does not evaluate longer sustained attention. Mesulam (1985) developed a visual cancellation test, involving four parts, where a target letter or sample is marked without marking other letters, in an array of 374 letters. There are 60 targets and 314 distracters in each of the four parts. This letter format is presented in organized and disorganized arrays. This is also true for a target shape that is presented in organized and disorganized arrays. This test can be considered a simple continuous performance test (Rosvold et al., 1956, Mezger & deLange, 2005). When looking for a simple, non-mechanized method to assess sustained attention, Mesulam's organized letters, used in the way that Strub and Black used their letters, seemed appropriate. Administering this test takes around four minutes.

Interpretation:

As can be seen from the normative data, the general population of individuals who are visually impaired, as opposed to individuals who are neurologically damaged, make few omission errors and even fewer commission errors. Large numbers of commission errors, say five or more, would indicate some difficulty with response monitoring, perhaps impulse control, or response control. It is worth noting if these errors continue for the entire test, or the individual develops control as the test proceeds, with the errors mainly in the first portion of the test.
The number of omission errors are considered to indicate the adequacy of sustained attention over this four-minute time period. In general, seven to nine omission errors would be considered mild attention problems; 10 to 13 omission errors moderate attention problems; 14 or more omission errors would be considered severe attention problems, while 19 or more omission errors would be considered profound attention problems. It is worth noting whether the omission errors tend to increase as time goes by, as would be common in ADHD, or if the omission errors are pretty steady; or if the omission errors tend to decrease as the task goes on, suggesting an adaptation

Digit Symbol

Chapter 12

Spatial Learning and Memory

Patterns (Page 45):

The Digit Symbol Test is another subtest of the Haptic Intelligence Scale. The Digit Symbol Test involves recognizing information, in this case number of dots, associated with stimuli (shapes), in a timely manner. Although not a standard part of the Digit Symbol Test, an incidental memory component can easily be added. Incidental memory, in this case, refers to the memory for the number of dots associated with particular shapes on the Digit Symbol, tested without forewarning; thus, it is memory incidental to doing the task. After the 120-second time limit is up on the Digit Symbol task, the guide equating shapes and numbers on the subject's left side of the board can be taken away, and the subject can continue to answer what numbers go with the remaining shapes. By keeping track of responses for the six shapes, until all have been responded to three times, it should be reasonably clear how many of the associations are encoded into memory. Obviously, if it is remembered correctly on one of the times, and not the others, it should not be considered an accurate memory.

Appendix IV

Interpretation:

A number of functions would appear to go into the performance of this test. Haptic identification of the shapes, and the ability to recognize the number of dots on the shapes, would be essential. Secondly, speed of processing the information to use this shape-number code would also be a factor. Finally, this is a new learning task, with the learning of the procedure and of the shape-number code combining to increase the speed and thus the score on this test. The new learning can be further evaluated by how well the subject has learned the associated pairs, when tested with the optional Incidental Memory

Procedure, at the completion of the two-minute trial.

There is also a minor spatial component of this, as especially early in the test, the individual will be trying to find the same shape in the guide column. This is spatial memory, as well as spatial sense of position. Some individuals will quickly learn the shapes and answers, without referring back to the guide column. It should be noted that a number of individuals will have difficulty distinguishing the first and fourth shapes from each other, as well as, second and third shapes from each other, as these are basically the same shapes, but oriented differently. Therefore, these shapes may bring out a spatial-orientation problem.

Block Design

Chapter 11
Spatial Ability

Spatial Analysis and Construction (Page 43):

As mentioned above, most hands-on tests given to individuals with visual impairments involve spatial understanding. Tests most heavily weighted, in this regard, would be the Block Design and Object Assembly Test from the Haptic Intelligence Scale, the Spatial Analysis Test from the Cognitive Test for the Blind, and the Spatial Constructive Subtest from the Vision Independent Cognitive Screen, using rectangular blocks. The Block Design and the Spatial Analysis Test assess how the individual not only perceives space, but analyzes it and breaks it down to reassemble it. However straightforward this may sound, Miller and Skillman (2008) make an excellent case for tactile and visual block construction tasks being so different in terms of task demands that they cannot be interpreted the same. They found, for example, that rotational errors were more difficult to resolve, using the tactile blocks. They also note that haptic encoding of the tactile designs is more local, and piecemeal, than the more cohesive visual encoding of the same designs.

Chapter 24
Low Birthweight and Blind: A Pervasive Developmental Disorder **(Page 90):**

Two subtests of the Haptic Intelligence scale, Block Design and Object Assembly, were selected to further explore aspects of VLBW individuals’ spatial dysfunction. These were selected since Block Design is a tactual-spatial analysis and construction task, and Object Assembly requires spatial knowledge and a parts-to-whole spatial problem solving.

VLBW individuals were compared to the OVI group again. Anyone with significant dexterity problems was excluded from the study, since Object Assembly has high dexterity demands. Table 24.4 shows the results of these comparisons.

The results in table 24.4 indicate that performance on these measures shows a dramatic deficit for the VLBW group. This is especially true on Block Design where most of the VLBW individuals received no credit. The highest Block Design raw score was 3, so all members of this group were deficient on this test. Breaking apart the early onset group (EOVI) from the OVI group yielded almost identical results with the EOVI group performing much better than the VLBW group. It would appear that the spatial sense needed for these two different construction tasks are the most impaired of a range of impaired spatial abilities.

Appendix IV

(Page 150):

Block Design does not show a decline with age, until the 45 and over age group. On the other hand, Object Assembly scores hold up well across the age groups. This is interesting in that Object Assembly also appears to hold up well for the Neuro group (see Table V.4), but not for the VLBW group (see Table 24.4) where the VLBW group is significantly worse on the task.

Block Design, while not showing age-related decline until 45 and over, does show a decreased performance for the Neuro group (Table V.3), but this does not reach the 0.05 level of significance (0.08). With the VLBW group, however, the impairment on this test is dramatic (see Table 24.4). VLBW adults were very impaired on this test.

Interpretation (Page 152):

It is important for the individual to have the tactual perception to differentiate rough from smooth. If this is not the case, the results of the test would not be considered valid. If there is any question, see if the individual can differentiate if a block face is completely smooth, or completely rough.

Many individuals have difficulty with the half smooth half rough sides. This may not be a tactual issue.

Presuming the individual can differentiate rough and smooth, then abilities to perform on this test would seem to be the analysis of pattern, and the construction of patterns. Note if the subject double checks the pattern(s) made with the target pattern(s). This will give information as to a level of thoroughness, conscientiousness or strategy in approaching the task.

Once the pattern is analyzed, it has to be reconstructed from the blocks. Some individuals who are very impaired do not understand that the blocks need to be in a square, even after being corrected on the sample. This would suggest very poor spatial understanding. For those who do put the blocks in a square, then it becomes an issue of how well they have analyzed the pattern, and reproduced the pattern. Formal scoring is only done in a pass/fail fashion, but it is usually reasonable to notice how many blocks out of four were correctly placed, to see if the individual is getting close, or simply has no idea of how to reproduce the pattern.

The haptic-spatial understanding to perform well on this test is significant. For many individuals, this is the hardest of the HIS subtests to understand and perform well on. It is not unusual for lower-functioning individuals to receive no credit on this test. The examiner, using this test, will find that there is an extra plate that is not used in the scoring. This plate could be used for high scoring individuals, to extend the analysis of their ability. There are no norms available for using this extra plate, but it does appear to be a design that is among the most difficult of the designs on this test.

Adults with a history of very low birth weight were compared to the group of other adults with visual impairments who were neither low birth weight nor had a history of neurological disorder. Haptic subtests used in this comparison were Object Assembly and Block Design; both test results were significantly lower in terms of raw score for the low birthweight group than the other group. For Block Design, the average raw score for the low birthweight group was 0.29 (standard deviation 0.77), while the average Block Design raw score for the other group was 7.99 (SD 7.03). This difference was significant at the < 0.0001 level. This underscores how difficult this test is for persons with compromised spatial abilities. It appears that more than half of the low birth weight group received no credit on this test. With the low birthweight group of 20 persons, the highest Block Design raw score was 3, as opposed to a raw score of 21, as the highest score for the group of visually impaired adults without very low birthweight or neurological history.

Object Assembly

Chapter 11
Spatial Ability

Spatial Analysis and Construction (Page 43):

As mentioned above, most hands-on tests given to individuals with visual impairments involve spatial understanding. Tests most heavily weighted, in this regard, would be the Block Design and Object Assembly Test from the Haptic Intelligence Scale, the Spatial Analysis Test from the Cognitive Test for the Blind, and the Spatial Constructive Subtest from the Vision Independent Cognitive Screen, using rectangular blocks. The Block Design and the Spatial Analysis Test assess how the individual not only perceives space, but analyzes it and breaks it down to reassemble it. However straightforward this may sound, Miller and Skillman (2008) make an excellent case for tactile and visual block construction tasks being so different in terms of task demands that they cannot be interpreted the same. They found, for example, that rotational errors were more difficult to resolve, using the tactile blocks. They also note that haptic encoding of the tactile designs is more local, and piecemeal, than the more cohesive visual encoding of the same designs.

The Object Assembly Task involves putting together pieces without foreknowledge of what the pieces will make. Is the individual able to identify a whole from its parts, and understand how these parts might fit together? The Haptic Memory Recognition Subtests from the Cognitive Test for the Blind also takes considerable spatial analysis in order to be successful in the memory trials. The Pattern Board for the Haptic Intelligence Scale also involves spatial analysis and memory, but it is simpler in concept and much easier to use verbal encoding in order to perform well.

Chapter 24

Low Birthweight and Blind: A Pervasive Developmental Disorder **(Page 90):**

Two subtests of the Haptic Intelligence scale, Block Design and Object Assembly, were selected to further explore aspects of VLBW individuals' spatial dysfunction. These were selected since Block Design is a tactual-spatial analysis and construction task, and Object Assembly requires spatial knowledge and a parts-to-whole spatial problem solving.

VLBW individuals were compared to the OVI group again. Anyone with significant dexterity problems was excluded from the study, since Object Assembly has high dexterity demands. Table 24.4 shows the results of these comparisons.

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The results in table 24.4 indicate that performance on these measures shows a dramatic deficit for the VLBW group. This is especially true on Block Design where most of the VLBW individuals received no credit. The highest Block Design raw score was 3, so all members of this group were deficient on this test. Breaking apart the early onset group (EOVI) from the OVI group yielded almost identical results with the EOVI group performing much better than the VLBW group. It would appear that the spatial sense needed for these two different construction tasks are the most impaired of a range of impaired spatial abilities.

Appendix IV

Interpretation **(Page 154)**:

Object Assembly is a parts-to-whole assembly task where the individual is given no foreknowledge as to what the completed assembly will be. Many individuals can reason from these parts as to what the object is; this should be noted. For many individuals, this parts-to-whole reasoning would be a problem-solving process, as well as parts-to-whole construction.

Observation of manual dexterity should be done during this testing as this is part of the process. Individuals with poor dexterity, poor coordination, or poor bi-manual coordination will have difficulty on this task, even in the absence of spatial difficulties. Naturally, some spatial understanding is needed, as is tactual identification. Speed can enter into the score, as well as, how the person learns procedures from trial to trial.

This test is useful in a vocational battery, in order to see assembly skills in general. At times, there may be a wish to sort this out from all the other factors that go into this test. In this testing of the limits, the person could be presented with the hand, most often, in its completed form. After allowing the individual to study it, and name what it is (or the examiner can name it), the pieces can be taken apart again giving the subject another chance to put it together. If the person still cannot get it together close to accurately, he or she will likely have poor assembly skills, in any situation. More simplified testing the limits assembly uses the block, providing the individual was not able to get the block together correctly. This type of shape is usually easily understood, given that each piece is identical.

When observing the subject's performance on this test, it is worth noting not only how well the individual understands what the object is, but once understanding it, how well the person is able to put it together. It is not unusual for the doll to be correctly identified, but then to have mistakes in the assembly (note above the scoring for the perfect reversal on this item).

On the Block item, it is not uncommon to see individuals put the first three pieces together correctly, but then have difficulty getting on the fourth piece. That is, if three pieces are together, the fourth piece will not go on, unless one of the pieces is taken off, and then the two sets of two pieces are put together to complete the task. Individuals who cannot reverse their strategy, by taking one of the three pieces off, may have difficulty with flexibility of approach in problem solving.

All in all, this subtest gives a good idea of a person's functioning in terms of dexterity, parts to whole assembly, and spatial reasoning. Speed is a factor, but it is not as much a speed test as Digit Symbol.

A comparison was made between Object Assembly scores for very low birth weight individual’s (1000 g or less) raw scores on Object Assembly (N=15), and those of persons with visual impairments who were neither very low birth weight nor had a history of neurologic disorder (N=125). The very low birth weight group (VLBW) scored significantly lower than the other group (OVI) at a significance level of < 0.0001.

The mean raw score for VLBW group was 5.80 (SD 3.17) (roughly scaled score of 2 to 3), while the mean raw score for the OVI group was 12.37 (SD 6.29) (roughly scaled score of 5 to 6). It would appear that individuals with VLBW have a significantly more difficult time with this task. This may be due to poor tactual understanding of objects, poor spatial sense, or general slowness. It did not seem to be due to dexterity problems. Block Design was also significantly lower, which takes minimal dexterity. No person in the VLBW group scored higher than a raw score of 10. The OVI group’s range was up to a raw score of 25.

Unlike the VLBW group, the Neuro group did not do substantially worse than the OVI group on Object Assembly. Table V.4 shows only about a one point mean raw score difference between the two groups. The hands-on, somewhat familiar nature of the Object Assembly test may have helped the Neuro group overcome any deficits that might be present.

Pattern Board Test

Chapter 12
Spatial Learning and Memory

Patterns **(Page 45):**

The Pattern Board Test (Appendix V) lends itself more than most tactual-spatial memory tests to verbal mediation. So, even though this is considered a spatial test, this spatial memory component cannot be separated easily from the verbal memory component. The Pattern Board Test involves studying patterns of pegs, in a five by five hole peg board, with a peg permanently affixed to the center. The memory recall trial is immediately after the study period. The complexity of the peg patterns increases as the quantity of pegs increases from one through eight pegs. There are time limitations, both on the study time, and on the time available to complete the tasks as the test time progresses.

Chapter 13
Spatial Distortion

Instruments to Assess Spatial Distortion **(Page 47):**

There are other tests that can give information about understanding of spatial areas that are more structured than the Pattern of Search Test. This is particularly true of the Tactual Formboard Test and the Pattern Board Test. The Spatial Pattern Recall and the Haptic Memory Recognition Test may also contribute to this. The Block Design Test from the Haptic Intelligence Scale is not as useful, in this regard, as such a small area is used. Mangiameli (2003) has a test called the Tactual Search Board that is large enough to be able to observe which areas of space are not receiving attention.

. . .

The Benton Visual Retention Test (Strauss et al., 2006), for sighted individuals, can be scored for errors on the right, or left, side. The Pattern Board Test might be considered roughly analogous to this, in that it can be observed in the reproductions from memory as to the right and left side; and that there seems to be a predominance of errors on one side or another, to a significant degree. Or, it might happen that the whole remembered pattern is shifted, in some direction, from the original. Such anomalies on one pattern is likely not meaningful. Repeated errors of a consistent type are what are noteworthy. Spatial distortion is certainly not seen in every visually impaired person, but when it is, it is important to understand. Then, the individual, and the people working with the individual, can compensate for it, based on feedback from the examiner. When individuals are told of their spatial distortions, revealed by the testing, they often recognize on their own how this has been evident in their daily lives.

Appendix V

Interpretation (Page 156):

It may be worthwhile, to some examiners, to indicate what parts of the pattern were done correctly, and where the errors were. For example, if the errors tended to be on the left side or if the whole pattern was moved to the right, this may suggest some problems with the individual's left spatial field. If the pattern is moved towards the subject, this may suggest that the subject tends to shrink space, or ignore space farther away from him or her. It is worthwhile to encourage the individual to double-check his or her work on the sample item, but this is not done later. It can be noted whether the individual was thorough and cautious enough to double-check the work, or simply places the pegs and says that he or she is finished. Some individuals will become overwhelmed when they are introduced to the eight-peg pattern. If so, it can be observed whether the individual appears to recover, and put forth a reasonable effort, or seems to shut down.

It should be apparent that this is a test of immediate spatial memory. However, many individuals will use some sort of verbal pattern, such as counting position in rows; counting, for example, the third piece in the second row, using verbal encoding to enhance the spatial memory. It may be worthwhile to ask the individuals how they went about remembering the patterns, at the completion of the test. Otherwise, it is obvious in observing some individuals how is was being done.

A third possibility is using a kind of kinesthetic memory, where individuals might see how much of their hand span is taken up from the center peg, to the peg they are trying to remember, for example. Whatever the pattern of approach, it is reasonable to interpret this as a spatial memory task, but spatial memory on this task cannot be easily differentiated from verbal memory. Understanding the patterns in the first place is involved in most individuals' performances unless they are totally verbally encoding, by row and column. Occasionally, the subject will miss simpler items, such as the sample item or item number two, but be able to get more difficult items. It might be hypothesized that with such individuals, they are slow to perceive the patterns involved, but once they do they catch on and are able to perform.

Comparison with other tests involving memory for spatial locations on the Tactual Formboard, or the Pattern Recall Test can be done. Significant differences here may be due to verbal encoding. Still, the nature of the three tests mentioned are quite a bit different from each other.

Pattern of Search Test

Chapter 11
Spatial Ability

Testing of Spatial Understanding (Page 42):

Poor performance on location recall, combined with poor performance on the Thoroughness portion of the Pattern of Search, predicts those who will not likely be independent travelers (See Appendices III and VII). However, some individuals with similar brain injuries, who start out just as poorly but are able to show improvement, especially in the later trials and on the memory and location portions of the test, will receive different rehabilitation recommendations. For the first individuals, the likelihood that they would ever be independent travelers is slim, and training should take that into account. For the second group of individuals, even though they are having difficulty in their travel training, the teacher should be encouraged to continue, as they have shown improvement in spatial understanding with enough exposure.

Chapter 12
Spatial Memory and Learning

Patterns (Page 45):

The Pattern of Search Test is primarily an executive function and spatial understanding test. However, there is a memory component as the individual has to remember, if being systematic at all, what territory has been covered and what has not. It is not unusual to see some portions of the area to be searched excessively, and others left relatively unsearched. If there is other evidence of reasonable strategy, and some thoroughness of search, then this may be a failing in spatial memory.

Chapter 13
Spatial Distortions

Pattern of Search Test (Page 47):

The Pattern of Search Test involves the assessment of two main abilities. The first is the executive function of planning and executing a strategy of search. The second is the thoroughness of the search itself. Although the test has a relatively small area to be searched, it does seem to bring out spatial distortions that are also evident on a larger scale. (See Appendix VII for details on the Pattern of Search Test.) The Pattern of Search results are not always as dramatic as in cases of hemineglect, but they are often helpful in understanding an individual's difficulty with space. All portions of the page, even the center, have been found to have been ignored by different individuals.

The summary scores for plan and thoroughness on the Pattern of Search do not give information as to what part of the area was not searched. When giving feedback to individuals, they can be told that if they are looking for something, for example on a desk, in the kitchen or on the floor, they may tend not to search the area as indicated on the Pattern of Search Test. Generally, individuals acknowledge they do have trouble with search and, at times, will eventually search that area. Or, he/she will give up on trying to find something only to have it pointed out that it was in that spatial area that he/she tends to neglect on the test and in individual activities.

Chapter 24
Low Birth Weight and Blind, A Pervasive Developmental Disorder

Symptoms (Page 90):

The Pattern of Search Test (see appendix VII) was designed to measure planning and thoroughness of spatial exploration. The VLBW group was compared to the OVI group on the planning measure, the thoroughness measure and the total score. See table 24.3.

• • •

It can be seen in Table 24.3 that the VLBW group scored lower on the measure of planning (highest possible score of 60), but not significantly lower than the OVI group on thoroughness (highest possible score of 60). The combined total score also showed the VLBW people scoring lower. The same comparisons were made for the VLBW group, and the group of visually impaired individuals with early onset, which yielded basically the same results. It can be concluded that in this sample, the adults born very prematurely, with very low birth weights, are deficient in spatial planning and exploration of spaces.

Appendix VII

Pattern of Search Test (Page 166):

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the Planning score for the Pattern of Search Test would tap some aspect of executive functioning; particularly the ability to plan and then implement a strategy. Experience with this instrument does suggest that individuals who do poorly on the planning part of the test also do poorly on other aspects of planning and executive functioning in general.

It also can be hypothesized that poor thoroughness on this test is related to poor spatial understanding, or spatial distortions in general. Indeed, individuals whose performance on this test indicates poor thoroughness, have other difficulties with spatial functioning. We can see correlation with TFBT location scores on this test. It can be noted that adults who were low birthweight babies who tend to have difficulties with spatial understanding and spatial memory, do poorly on this test. They also tend to do poorly on the Planning part of this test, but not much is known about their executive functioning.

The spatial difficulties of very low birthweight adults are readily apparent to almost anyone who observes them. It is also being observed that individuals who have hemineglect would also neglect that side of the space, on this particular test. Some examples are shown at the end of this Appendix.

Interpretation (Page 168):

The Plan score can be interpreted to indicate the executive function of spatial planning. The higher the score, the better the function of spatial planning. This score would also be affected by spatial understanding to some degree, and the score is correlated with the Thoroughness score.

A small number (23) individuals had scores on Oral Trail Making and on Pattern of Search. There was a positive relationship between the Plan score and the Oral Trail Making time score, but it was small (r=.40). This may mean that they tap very different aspects of executive functioning, in addition to comparing a verbal test to a nonverbal, spatial test.

In general, it can be seen from the data that neurologically-involved adults, with visual impairments, do not have lower scores on planning and thoroughness. Adults with very low birth weight and blindness do have lower scores than other blind adults.

The records of 44 participants were reviewed to see if the Pattern of Search scores were related to independence in travel, and independence in the kitchen.

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This method yielded the following results: Forty-five percent of independent travelers scored above 90 (range 96-111) while 9% of non-independent travelers scored above 90 (range 93-103). None of the independent travelers had a combined score of less than 55, while 33.3% of the non-independent travelers scored below 55 (range 33-47).

It would appear, based on these results, that a combined score of less than 50 would predict about one third of non-independent travelers accurately, without labeling any independent traveler as non-independent. It is reasonable to interpret someone's combined score below

50, as indicating that the person would not likely be an independent traveler. Certainly, more research using the POS and TFBT is needed to explore the vital area of travel for the visually impaired adult, but this conservative cutoff seems justified at this time.

The prediction of independence in kitchen skills yielded a different result, using the POS measures. The Plan score was positively related, but did not reach the 0.05 statistical significance level. The Thoroughness and Total scores seemed to have no discernible relationship to kitchen independence. It may be that there are so many other variables involved, that anything measured by this test is overshadowed. Kitchen skills were likely very dependent on history, to name one possible variable. Kitchen skills may be less reliant on spatial ability than travel.