4.4   Visual Attention

Evaluation of visual attention is based on the concept that how efficiently and completely a person attends to and assimilates visual information determines how effectively they can use the information to complete activities. The evaluation assesses two important components of visual attention: visual search and scanning, and internal conceptualization of space. Cancellation tests are used to measure visual search and scanning; design copy is used to measure conceptual representation of space.

4.4.1   Assessment Considerations

4.4.1.1   Assessment Accommodations

As a skill found at the intermediate level of the visual perceptual hierarchy, visual attention is affected by deficits in the foundation visual functions: visual acuity, oculomotor control, and visual fields. It's important to evaluate these functions prior to measuring visual attention and make accommodations to minimize their influence on performance. Aphasia and motor impairment can also affect performance on these tests. A client with aphasia may have difficulty completing the subtests containing letters and words and perform better on those that use shapes. Examples of possible modifications include:

- The biVABA includes two visual search subtests that use symbols as targets (*complex circles search-structured and random)*. The "no" symbol was specifically chosen as the target for these subtests because it is familiar symbol.

- A client experiencing diplopia should wear occlusion to eliminate double images.

- For clients who have difficulty with numbers or physical limitations, the test instructions for *the random plain circles-simple and crowded* can be modified by instructing the client to use a marker to fill in the circles (instead of numbering them) while you observe the client and record their search pattern on a separate form.

- You can also build up the marker to make it easier to grip or use a chisel point marker

4.4.1.2   Why use Cancellation Tasks?

The biVABA visual search subtests are cancellation tests.[244] These tests require the client to locate and "cancel" out a target hidden among distractors arranged in a structured (e.g., in rows) or unstructured array (e.g., randomly scattered on the page). The client is instructed to search the array and locate as many targets as possible. Completion time and accuracy are typically used as performance measures.

Cancellation tests enable you to observe how the client searches for information and determine whether the client's ability to initiate and execute an efficient search pattern is influenced by

the structure and complexity of the visual task. Specifically, they help answer these clinical questions:

1. Does the client initiate and use a structured search strategy?
2. Does the client carry out the search pattern in an organized, efficient way?
3. Does the client completely search the visual array to locate all of the targets?
4. Does the client's performance decrease as the complexity or density of the visual array increases?

Adults without brain injury use specific search strategies to ensure an accurate performance on cancellation tests.[17, 259] These include strategies that are linear, organized, symmetrical, thorough, and consistent. Warren, Moore and Vogtle[259] studied the performance of typical adults on the biVABA visual search subtests and found that most participants:

- Used a left to right/top to bottom linear (reading) strategy (see Table 4.4.1 and Figure 4.4).
- Consistently employed the same search strategy to complete a *single* subtest.
- Consistently employed the same search strategy to complete *all* subtests.
- Checked the accuracy of their work especially on the first subtest and on subtests with complex arrays. Older adults checked the accuracy of their work more frequently than younger adults.

Research has also shown variability in search performance among adults without brain injury. Benjamins et al.[17] in a large study of 523 typical adults identified a small cluster of participants who omitted targets on a cancellation test (N=18); another cluster who revisited previously cancelled targets (N=18) and a larger cluster (N=125) who accurately cancelled targets using inefficient search strategies. The Warren et al. study[259] also found variability in the participant's search strategies on the biVABA visual search subtests. A small percentage of participants (1-4 %) used search patterns other than the left-to-right, top-to-bottom strategies and a small percentage (< 10%) switched search strategies during the subtests. There is no difference between men and women on performance, but age does influence performance, with older adults completing cancellation tests more slowly than younger adults.[17] Tables 4.4.1 and 4.4.2 describe the findings from the Warren et al. study (see section 4.4.4.2).

Research conducted as far back as the 1970's has established the efficacy of using cancellation tests to identify neglect. This research showed that persons with neglect use visual search patterns that reflect three characteristics of neglect: 1) inattention to the left side 2) difficulty focusing and sustaining attention and 3) difficulty searching complex arrays that place greater demand on visual attention.[2, 188, 225, 244, 264] Table 4.4.3 (see section 4.4.3.1.3) describes the key observations on cancellation tests associated with these characteristics.

4.4.1.3   Right vs. Left Neglect

Left neglect is more common than right neglect-present in nearly half of persons in the early stages of recovery from a right hemisphere injury (see section 2.5.2.2).[244] Its primary characteristic-spatial bias against the left and towards the right side-is observed as an omission of targets on the left side of the visual search subtests. Right neglect can and does occur but

exerts a less obvious influence on visual search.[277] The client may show no signs of inattention to the right side on subtests with structured and less crowded visual arrays (*single letter search-simple, word search, random plain circles-simple, random plain circles-crowded)* but show inattention to the right on subtests that stress attentional capabilities (*random complex circle search*).

4.4.1.4   Distinguishing Between Left Neglect and Left Hemianopia

Left neglect is often confused with left hemianopia because both conditions may cause the client to be unaware of visual information on the left side. But they are distinctly different conditions and do not have the same long-term effect on performance. Therefore, it is important to distinguish between the two conditions by carefully observing the strategy the client uses to locate targets on the visual search subtests.

As a primary sensory loss, hemianopia may prevent the client from accurately seeing the affected field, but it does not impair the client's attentional capability. Perceptual completion (see section 2.4.3.1) may limit the client's search towards the blind field resulting in an abbreviated search pattern and omissions on the visual search subtests. But when cued to search for targets on the blind side, the client will use attention to direct eye/head movement towards that side. The client will also employ attention to initiate and carry out an organized search pattern and to rescan an area to check for accuracy.

In contrast, clients with neglect lose the attentional mechanisms that drive the search for visual information. The client may make no attempt to search for information on the left side and display little eye movement or head turning toward the left side. When searching for targets, the client will often use a disorganized, random, and asymmetrical pattern that is initiated on and confined to the right side.[36, 244] The client often searches quickly and does not check for accuracy. When left hemianopia is combined with left hemi-inattention, the client experiences the most severe form of neglect (see section 2.5.2.2). The client's hemianopia causes him to miss visual information on the left side and his hemi-inattention prevents him from using attention to compensate for the hemianopia and search the left side. The hemianopia exaggerates the client's inattentive behavior on the assessments and increases errors on the visual search subtests. When the conditions occur together it is important to determine the severity of the inattention as this will determine whether the client is able to learn the strategies needed to compensate for the hemianopia.

4.4.1.5   Nonlateralized Inattention

Persons with right hemisphere injuries may also experience non-lateralized inattention (see section 2.5.2.2). This disrupts the client's ability to initiate and sustain attention.[2, 185, 245] Table 4.4.4 describes the key observations of non-lateralized inattention on the visual search subtests.

4.4.1.6   Importance of Providing Cues and Do-Overs

The purpose of evaluation is to determine the client's strengths and weaknesses in using vision to participate in daily occupations. When assessing attention, the purpose is to determine whether and how well the client is able to use attention to search for visual information. *Cuing* provides an opportunity to observe the client's ability to use attention to improve search performance. If cuing improves the client's performance, add it to your intervention toolkit and share it with the rehab team. If cuing does not improve performance, remove it from your toolkit and focus on modifying environment and task to enable the client to use their limited attention to complete occupations. Visual, physical, and verbal cuing is allowed and encouraged when assessing the client. Use it sparingly and provide it only when it is apparent that the client cannot correct performance without assistance. *Do-overs* provide an opportunity to observe whether the client can use feedback to improve performance. A client who uses feedback to improve performance demonstrates the ability to use attention/cognition to compensate for vision impairment suggesting good rehabilitation potential. A client who is unable to use feedback to improve performance will require more task modification and structure to compensate for their attention deficit. This valuable information helps you set an appropriate rehabilitation goal.

4.4.1.7   Why are the Subtest Forms so Wide?

The wider format of legal-size paper improves the sensitivity of the test to detect deficiencies in visual search due to neglect and hemianopia. The inconvenience of purchasing legal size paper for the copier and filing the larger form is offset by a better opportunity to observe the client's strengths and weaknesses.

4.4.1.8   Why are There so Many Subtests?

The 7 subtests have specific characteristics that allow you to observe a different aspect of the client's ability to direct visual search and attention. As a group, they feature simple to complex visual arrays with structured and unstructured formats.
- Subtests with *Structured Visual Arrays* (single letter search simple and crowded, word search, structured complex circle search) require the client to search through targets arranged in an organized, linear format. The structure of the array cues the client to use a "reading pattern" to search for targets-moving row by row or column by column. The structure also assists the client to maintain their place as they search each row.
- *Subtests with Unstructured visual arrays* (random plain circles-simple and crowded, random complex circles search) require the client to search for targets arranged in a random format. The client must use attention to impose a structure on their search pattern as they complete the subtest.
- The *random plain circles-simple and crowded* subtests were designed to provide tangible documentation of the client's search pattern. By numbering the circles, it is possible to see the pattern the client uses to shift attention from target to target. These are also the only subtests where the client is told the exact the number of targets to

locate. The combination of knowing the number of targets and sequentially numbering them may help client accurately complete these subtests. Administering these subtests can help you determine if providing an explicit outcome will strengthen the inattentive client's ability to sustain attention.

4.4.1.9   Do I Need to Administer the Visual Search Subtests in a SPECIFIC Order?

The short answer is NO-there is no requirement to administer all of the subtests or to use any specific order. The advantage to giving every subtest is that it increases the sensitivity of the test and provides the best indication of the client's ability to modify visual attention to meet the demands of increasingly difficult tasks.[11] When given in the order on the assessment form the subtests place increasing demands on the ability to direct and sustain attention to help determine whether there is a ceiling/limit to the client's ability to employ visual attention. The disadvantage is that it can take 15-30 minutes for a client to complete all 7 subtests depending on their limitations.

Use your limited time wisely and select the subtest *that helps to answer your clinical question.* Select the order and number of subtests based on what you want to learn about the client's attentional capability. When time is limited, select 1-2 subtests that will help confirm or expand your initial impression of the client's attentional capabilities based on your clinical observations. The following examples describe different clinical scenarios for selecting subtests.

- *Example 1*: Your new client is 9 months into recovery. He wants to resume driving and asks to be referred for a driving evaluation. The medical notes indicate that he had left neglect in the early stages of his recovery. You want to know whether he is still inattentive to the left side. Selecting the *random complex circles search* subtest will place the most demand on the client's attentional capabilities. If he performs well on this search subtest (e.g., attending to both sides of the form and using a structured pattern to accurately search for targets) you can move onto other assessments that evaluate his ability to attend and quickly respond in dynamic environments to help decide if he is ready for a driving assessment. If he performs poorly on the subtest (e.g., uses a random pattern to search for targets only on the right side of the form) it suggests that he is not yet ready to resume driving. To get a clearer understanding of his current abilities and you may want to observe how he performs on less demanding subtests that use a structured format (*structured complex circles search*) or more obvious targets *(single letter search-simple or crowded)*. Findings from these subtests will help select an intervention to strengthen those skills.

- *Example 2*: Your new client is in acute care-1-2 days into recovery: The newly hospitalized client is sleep deprived, adjusting to medications, and traumatized by the circumstances that caused the brain injury. All of these factors will strongly influence the client's ability to attend. Instead of a using search subtest at this early stage of her recovery, it is best to assess her attention by observing her complete selfcare activities using an evidence-based instrument like the *Catherine Bergego Scale* (see section 4.5.5.2 and Appendix D). If you want to use a visual search subtest to screen for

inattention, *the random plain circles-simple* is a good option because the directions are simple, and the test is short. This subtest will also produce a visual depiction of the client's ability to search both sides of a visual array at this stage of her recovery and provide a useful baseline for progress.

- *Example 3*: Your client is in the early stages of recovery from a right hemisphere stroke and just starting intensive inpatient rehabilitation. Clients with a brain injury to the right hemisphere often experience neglect (see section 2.5.2.2) during the first weeks of recovery.[244] The initially observed neglect will resolve within the first year of recovery for most of these clients and only about a third with early signs of neglect will continue to experience long term (e.g., chronic) neglect.[120, 161] It's important to understand the client's strengths and weaknesses in visual search to select the most appropriate intervention and it's also important to establish a performance baseline to gauge recovery. In this scenario, administering all of the biVABA visual search subtests and the design copy test would provide the most comprehensive picture of the client's current strengths and limitations to provide a baseline for recovery. Evaluate the client in a quiet environment and consider reducing the effect of fatigue by giving one subtest a day.

- *Example 4*: Your client is beginning outpatient rehabilitation. Most neglect resolves within the first few months of recovery.[120] One way to track this recovery is to administer the visual search subtests to obtain a baseline performance and then periodically re-administer them to check improvement. You do not need to administer all 7 subtests: instead choose one with a structured array *(single letter search-simple and crowded or word search)* and one with an unstructured array (*random complex circles search*).

4.4.1.10   Why include a Design Copy Test?

Design copy also has a long research history-dating back to the 1940s. Observing the client copy a line drawing of a familiar object like a clock, house, or flower provides information about the ability to conceptualize space on the left side.[43, 244] Clients with left neglect from right hemisphere lesions may omit details on the left side of their drawings and elaborate, elongate and/or skew the drawing towards the right side, suggesting difficulty accessing a mental representation of the left side of the image.[38, 244, 115, 155, 189, 193]

4.4.2   Test Instructions

General Instructions to the Client:
> *"I am going to give you some tests to find out if you can look for information and objects in an organized way. Brain injury can cause your ability to search to become disorganized. This can make it difficult for you find the items and information you need to complete your daily activities. These tests look at how you use your vision to search and will help me figure out how to improve your ability to find the items you need."*

4.4.2.1   Visual Search Subtests

Test Items:
> Visual Attention Assessment Form
> Plastic templates of the subtests to make paper copies and score the subtests
> - Single Letter Search-Simple
> - Single Letter Search-Crowded
> - Word Search
> - Structured Complex Circles Search
> - Random Plain Circles-Simple
> - Random Plain Circles-Crowded
> - Random Complex Circles Search
> - 🚫 No symbol target card (flip side of clock design card) for complex circles search subtests
>
> Red fine tip marker
> Timer

Environment: well-lighted room with the light source directed from behind the client onto the tabletop to evenly illuminate the subtest; ensure that the light source does not shine directly into the client's eyes. This test requires the client's full concentration; ensure that the room is free from visual, auditory and physical distractions.

Procedure:
1. Seat the client comfortably at a well illuminated writing surface. The client should be wearing eyeglasses if needed for reading.
2. Use the subtest templates to make paper test forms for the client.
3. Place the paper subtest form at the client's midline.
4. Hand the client the red marker.
5. Instruct the client to cross out the designated target(s) and put the marker on the table when finished.
6. On the complex circle subtest-position the "no" symbol card directly above the paper where the client can clearly see it.
7. The client may reposition the subtest. Note these changes on the recording form.
8. Begin timing when the client initiates the search pattern.
9. Observe client's search strategy to locate targets and record it on the form.
10. Provide verbal, physical or visual cues if the client is struggling to locate targets (see section 4.4.1.6)
     > Examples of Verbal Cues:
     > - "*Remember the sheet is very wide*"
     > - "*There are more [circles/letters/words] on your [left/right] side*"
     > - "*There are [insert number] [circles/letters/words] on the sheet*"
     > - "*There are [insert number] circles left to find (on the left or right side)*"
     > - "*There are [insert number] letters/words left to find [on the left or right side]*"

Examples of Physical Cues:
- Gently turn the client's head towards the left or right side of the subtest.
- Place the client's hand on the left or right border of the subtest to draw attention to it.
- Point to the left or right border of the subtest.

Other Cues:
- Draw a bright red anchoring line on the left or right side of the subtest, remind the client to look for the red line (this cue often works well for the client with hemianopia but not the client with neglect).
- Provide an auditory cue on the neglecting side such as a chiming ring sound on your phone.

11. Stop timing when the client places the marker on the table.
12. Record the number of correct responses on the assessment form. The flip side of the plastic templates show the location of the targets to enable you to count the number of correct responses quickly and accurately.
    - Canceling the wrong target (e.g. an E instead of an F) is counted as an error.
    - Cancelling the wrong target **but immediately** correcting the mistake without cuing is **not** recorded as an error.
    - On the open circle tests-returning to a circle and numbering it again (e.g., double numbering) is a key observation and should be noted (Table 4.4.4, section 4.4.3.1.3); mis-numbering circles by going out of sequence (e.g., 1,2,4,5,) should also be noted.
13. Use the table in Appendix F to quickly calculate the percentage of correct responses.

Instructions to the Client:
Single Letter Search-Simple and Crowded
> *"There are seven rows of letters on this page. Read through the letters and cross out the **P** and the **F** every time you see them (point to the examples of the letters at the top of the form). Remember to cross out only the P and the F. When you are finished, place your marker on the table."*

Word Search
> *"There are seven rows of letters on this page. Included among the letters are the words **the** and **at** [point to the 2 words at the top of the form]. Search for these two words and underline them when you see them. Remember: only underline **the** and **at**. When you have found all of the words, place your marker on the table."*

Random Plain Circles-Simple and Crowded
> *"There are **20 (or 40)** circles scattered across this page. Number the circles in order as you see them. Place the number inside of the circle. When you have numbered all of the circles, place your marker on the table."*

Structured Complex Circles Search
> *"There are 6 rows of circle shapes on this page. Search through the circles and cross out the one that looks like this [point to "no" sign circle on the card and the*

top of the form]. Remember-cross out only the circle that looks like this. When you are finished, place your marker on the table."

Random Complex Circles Search

"There are many circle shapes scattered across on this page. Search through them and cross out all of the circles that look like this [indicate the card with the "no" symbol]. Remember-cross out only the circles that look like this. When you are finished, place your marker on the table."

4.4.2.2   Design Copy

Test Items:

Visual Attention Assessment form
3 design cards (house, flower, clock)
3 sheets of 8.5" x 11" paper
1 pencil

Environment: well-lighted room with the light source directed from behind the client onto the table to evenly illuminate the card and paper; ensure that the light source does not shine directly into the client's eyes. This test requires the client's full concentration; ensure that the room is free from visual, auditory and physical distractions.

Procedure:

1. Select a design card (house, flower, clock)
2. Provide 1 sheet of paper per design.
3. Place the sheet of paper and the design card at the client's midline.
4. Position the paper directly in front of the client; position the design card directly above the paper.
5. Instruct the client to copy the design as accurately as possible.
6. The client may reposition the paper or design card during the test. Note these changes on the recording form.
7. Provide verbal or physical cues if the client leaves off detail in the drawing
   Examples of Verbal Cues:
   - "Look carefully at [the figure] to make sure you have seen everything."
   - "Does your drawing look complete?"
   Example of Physical Cue:
   - Place client's hand on left or right side of the page to draw attention to that side.
8. Review the accuracy of the client's performance and record on the assessment form.

Instructions to the Client:

"Copy this drawing of a [house, flower, clock] as accurately as you can. Draw only what you see-do not add extra details. How well you draw is NOT important. But it is important to include all of the details in the drawing. Take as long as you need. Put your pencil on the table when you are finished."

4.4.3   Interpreting the Client's Performance on the Assessments

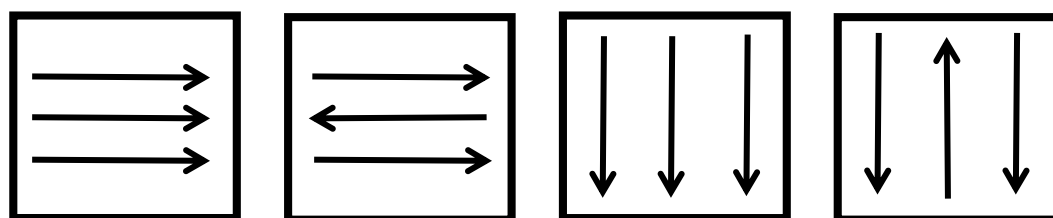4.4.3.1   Visual Search Subtests

4.4.3.1.1   Interpreting Accuracy and Completion Time

Many factors affect the ability to focus and sustain visual attention. Poor visual acuity, difficulty focusing, blurred vision and hemianopia affect accuracy identifying targets as can aphasia, medications, a noisy environment, and a good night's rest. It is not possible to state unequivocally that reduced accuracy on a visual search task is due only to visual inattention unless all other cognitive, physical, environmental and visual functions are accounted for and controlled during the assessment. This is the primary challenge when only scores for completion time and accuracy are used to determine that the client has visual inattention. The scores may provide a glimpse into the effect of ineffective search on performance but they do not provide information on how or why the client performed so poorly.

Providing effective intervention depends on identifying the client's strengths and weaknesses in visual attention so that strengths can be used to compensate for weaknesses. The biVABA is not a diagnostic assessment (see sections 1.6, 1.7), it is a tool to assist the OT to select the best intervention to obtain an optimal client outcome. Research has shown that adults with normal visual attention use varied strategies to complete visual search tasks,[17] but all *effective search strategies* have certain characteristics that deliver an accurate performance.[259] Research also shows that adults with neglect use ineffective search strategies that cause errors in visual search (see section 4.4.1.4). The biVABA visual attention subtests focus on the relationship between the search strategy the client used to complete the subtest and the accuracy of the client's performance measured as the percentage of correct responses on the subtest. Generally, effective search strategies result in good accuracy and ineffective search strategies result in poor accuracy. When this correlation is not observed, other factors may be influencing the client's performance.

4.4.3.1.2   Effective Search Strategies

It is necessary to understand the characteristics of successful search strategies in order to identify ineffective strategies. Adults without brain injury when tasked to search for targets on a cancellation test employ organized, efficient search strategies that enable them to quickly locate and identify targets. The Warren et al.[259] research on the biVABA visual search subtests identified the search strategies that enabled typical adults to complete the subtests efficiently and accurately (see section 4.4.1.2.). Most study participants used one of the search strategies shown in Figure 4.4.1. Table 4.4.1 describes the frequency that each pattern was used, and Table 4.4.2 shows the typical performance times on each subtest.

Horizontal Left to Right   **Horizontal Back/Forth**   **Vertical Left to Right**   **Vertical Back/Forth**

Figure 4.4.1: Typical search strategies on the biVABA visual search subtests.

Table 4.4.1: Frequency Study Participants Used a Specific Visual Search Strategy and Checked Their Work on the Visual Search Subtests.

Search Pattern	Single Letter Search Simple	Single Letter Search Crowded	Word Search	Structured Complex Circles Search	Random Open Circles Simple	Random Open Circles Crowded	Random Complex Circles Search
Horizontal L to R	65%	67%	86%	68%	62%	57%	43%
Horizontal Back/Forth	20%	22%	6%	21%	10%	11%	23%
Vertical L to R	5%	0%	0%	1%	11%	10%	1%
Vertical Back/Forth	1%	1%	3%	3%	9%	10%	11%
Vertical L to R	0%	0%	0%	1%	0%	0%	1%
Diagonal	0%	0%	0%	0%	1%	1%	0%
Circular	0%	0%	0%	1%	1%	3%	0%
Switched Strategy	7%	9%	3%	4%	4%	6%	18%
Other Strategy	0	1.2%	3%	1%	3%	3%	4%
Checks Work	40%	36%	26%	15%	1%	3%	32%

* The subtests were administered during a single session in the order shown in the columns. This may have contributed to the progressively lower percentage of participants checking their work until the last and most difficult subtest (Random Complex Circles Search).

** N = 81; Age Range: 26-86 years; 34 males, 47 females; 90% white; 30% over age 60 years

Table 4.4.2: Performance Times (in seconds) of Typical Adults on the Visual Search Subtests

Subtest	Median Time	Fastest Time	Slowest Time
Single letter search simple	63	32	141
Single letter search crowded	79	42	215
Word search	79	38	166
Structured complex circles	43	24	120
Random open circles simple	22	13	43
Random open circles complex	48	30	99
Random complex circles	60	24	196

4.4.3.1.3   Ineffective Search Strategies

Clients with neglect often employ ineffective search strategies that reduce accuracy on cancellation tests like the visual search subtests (See section 4.4.1.4). Clients who use an ineffective search strategy may not acquire sufficient visual information or acquire it in such a way that it can be used to accurately complete visual processing. Tables 4.4.3 and 4.4.4 describe ineffective search strategies observed in clients with neglect.[2, 36, 188, 225, 244, 264]

Table 4.4.3: Key Observations on Cancellation Tests that Suggest Neglect

Neglect Characteristic	Key Observation
Spatial bias-inattention to left side	Omits targets on the left side of the array
	Initiates search on the right side of the array
	Confines search to right side of the array
	Repeatedly searches the right side of the array (revisiting) instead of searching left side
	Does not respond to cues to search left side
Difficulty focusing/sustaining attention	Cancels similar but incorrect targets
	Stops before completing the test
	Searches quickly, misses details
	Searches slowly, skips over targets
Difficulty searching complex arrays	Initiates random search pattern
	Pattern becomes random as client searches
	Stops quickly-may show signs of fatigue
	Ability to locate targets decreases as pattern density increases within the array

Table 4.4.4: Key Observations on Cancellation Tests that Suggest Non-Lateralized Inattention

Neglect Characteristic	Key Observation
Difficulty generating attention	Slow to initiate search-requires nudging to start; may require therapist to physically place hand on the subtest
	Closes eyes during test, falls asleep
Difficulty focusing/ directing attention	Field dependent: indiscriminately engages with items in front of them or extraneous activities occurring around them
	Revisiting: repeatedly re-examines right side of array or target
	Perseveration: Repeatedly crosses out the same targets (usually on right side)-unable to progress through the array
	Uses a random search strategy
Difficulty shifting attention	Stays on a single target for several seconds after cancelling it
	Slow to shift attention to find a new target
Difficulty sustaining attention	Frequently, easily gets off task and requires redirection
	Quickly stops searching and puts marker down to end test before searching all rows to locate targets

4.4.3.1.4   Key Observations

The client demonstrates an abbreviated search pattern with omissions on one side.
Hemianopia and neglect both frequently cause an abbreviated search pattern. The *client with hemianopia* abbreviates the pattern because they do not see of border of the visual array on the "blind" side and is unaware that they have not scanned far enough to find all of the targets on that side. The client with neglect abbreviates the search pattern because they lack the attentional capability to search the neglected side. The key difference between the two conditions lies in the ability to use attention to direct performance. The client with hemianopia will use attention to initiate organized and predictable search strategies to locate targets. On structured arrays (the structured *letter, word, symbol search subtests*), the client will likely use a left to right pattern. On unstructured arrays (the *random open and complex circle search subtests*), the client may use a right-to-left pattern if the hemianopia is on the left side. Usually, when cued that there are unmarked targets on the blind side, the hemianopic client will turn the head and reexamine that side to locate the remaining targets. In contrast *the client with neglect* lacks the attentional capability to devise an efficient search strategy. The result is a random, unpredictable and inefficient search pattern that fails to locate targets on the affected side. The attention deficit also prevents the client from using cues to improve performance. Using an abbreviated search pattern to one side causes the client to miss visual information needed for reading, safe navigation and mobility, and ADLs that require attention to both sides of the body such as dressing. Table 4.4.5 summarizes the key performance observations that distinguish left hemianopia from left neglect on the visual search subtests.

Table 4.4.5: Key Observations: Left Hemianopia vs. Left Neglect on the Visual Search Subtests

Left Hemianopia	Left Neglect
Search pattern is symmetrical; Initiates left to right pattern but may begin in middle of the array	Search pattern is asymmetrical; initiated and confined to the right side of the array
Attempts to search towards left side of the array	No attempt to search towards left side of array
Search pattern is organized, structured	Search pattern is random, inefficient
Client rescans to check accuracy	Client does not rescan to check accuracy
Client effort and search time corresponds to the search demands of the array	Client completes task quickly; effort does not correspond to the search demands of the array
Responds to cues and improves search performance	Does not respond to cues or improve search performance
Client may use fingers on non-dominant hand to help guide search across the row	No attempt to use a strategy to help guide search across the row

The client uses an asymmetrical search pattern. This behavior strongly suggests neglect especially when observed on tasks with structured visual arrays such as the *single letter and word search* subtests.[11, 126] Instead of initiating search on the left side of the array and moving towards the right, the client demonstrates asymmetry-initiating search from the right side and confining search to the right side; does not typically cross midline. Use of the pattern significantly reduces the amount of visual information the client acquires during search. It may disrupt reading and navigation and disrupt the client's ability to locate items needed to complete ADLs.

The client uses a random search pattern. Observation of a random, unpredictable search pattern strongly suggests the presence of neglect.[36, 225, 264] Clients who use random search patterns are generally unable to gather cohesive information during visual search. It would be as though one tried to comprehend a novel by reading one sentence on page 34, another on page 67, and another on page 23. When the random search pattern occurs in conjunction with an abbreviated search pattern and/or an asymmetrical search pattern it strongly indicates that the client has neglect.[244] The severe disruption in information processing usually causes difficulty locating and analyzing visual information, and significant ADL limitations.

The client quickly completes the subtests making multiple errors. This performance suggests that the client has reduced ability to focus and sustain attention which is associated with non-lateralized inattention due to neglect (See Table 4.4.4).[185, 245] The client may have difficulty staying on task to complete ADLs.

The client slowly completes the subtest making multiple errors. Clients with significant visual impairment (poor acuity, visual field deficit, oculomotor impairment) or language deficits may require several minutes to complete each subtest and also make numerous errors. However, because they can maintain their concentration on a difficult task over an extended time, their low accuracy may be due to limitations other than inattention. Improvement in these other functions should improve the client's performance on the visual search subtests.

The client accurately completes the structured search subtests but makes numerous mistakes on the unstructured search subtests. This suggests that the client has limited attentional capability that breaks down as the demands on visual search increase. It is important to observe and compare the client's performance in a cluttered environment (e.g., a grocery store) to a less cluttered environment (e.g., a bedroom); and on tasks with relatively simple, uncluttered arrays (grooming) versus tasks with more cluttered, complex visual arrays (meal preparation). Simplifying and structuring tasks may facilitate independent performance.

The client accurately cancels targets on subtests that contain fewer targets and distractors, but accuracy decreases on subtests with more targets and distractors. Clients with neglect locate fewer targets when searching dense arrays containing many targets (*e.g., single letter search crowded*) and on arrays with many distractors (e.g., targets that are similar to the designated target) such as complex circle search.[226]

The client crosses out letters/shapes similar to the target. This could suggest that the client is unable to retain the target's salient features in short term memory to accurately distinguish between targets. When combined with a quick performance, it may suggest the client is unable to sustain fixation long enough to identify all of the salient features of the target. Both of these behaviors suggest neglect. However, if the client has a deficit in acuity, oculomotor or visual field it may simply be that client does not see the targets accurately. In either case, the client may have difficulty with activities with dense visual detail such as reading a bill or locating an item on a shelf in a grocery store.

The client skips lines on the structured search tests. Clients with left hemianopia can have difficulty accurately locating the next line of print due to difficulty/inability to execute an accurate long leftward saccade towards the blind field. This may cause the client to inadvertently skip lines of print. A client may also may skip lines due to inattention. A client with either condition may have difficulty reading accurately.

The client skips over and does not cross out targets. When the targets are omitted only on one side, it suggests the presence of a hemianopia or hemi-inattention or a combination of the two conditions (e.g., neglect). If the client randomly skips over targets throughout the subtest and has difficulty executing an organized search pattern, it suggests impaired non-lateralized inattention. Clients with a complete hemianopia that extends into the fovea may also randomly omit targets throughout a subtest but their search pattern is generally organized.

The client initiates a structured and organized search pattern at the start of the subtest but the pattern becomes disorganized and random as the test progresses. Clients with limited attention may show increasing difficulty engaging and maintaining attention. This may be due to reduced ability to sustain attention or fatigue from the effort of attending. The client may benefit from breaking tasks into shorter segments.

The client's overall performance declines as several subtests are administered. Clients with limited attention may show increasing difficulty engaging and maintaining attention as the

length of the testing session increases. This may be due to reduced ability to sustain attention or fatigue from the effort of attending. The client may benefit from breaking tasks into shorter segments.

The client double numbers the circle targets on the simple and crowded plain circle subtests or perseverates on cancelling the same target(s) on the search subtests. These behaviors suggest that the client has difficulty using working visual memory to direct visual search and sequencing.[155] Perseveration is commonly observed in persons with neglect.[38]

The client's performance improves in response to cuing. This is an important observation because it shows that the client can modify attention to improve performance. Most persons with hemianopia possess this capability but persons with neglect lack it. Determine the type of cues that work best for the client and incorporate them into interventions.

The client does not respond to cues to improve performance. This is an important observation because it shows that the client is unable to use attention to improve performance. Most persons with hemianopia possess this capability but persons with neglect lack it.

The client combines visual search strategies or switches strategies when completing a subtest(s). Research shows that a small percentage of typical adults combine or switch strategies especially if they feel that their initial strategy is too slow or inaccurate.[17, 259] If the client shows no other changes in visual search or attention and completes the subtest with acceptable accuracy you can chalk this up to personal choice.

The client uses a vertical search strategy on the letter and word search tasks. While most persons will, out of learning and habit, initiate a left to right horizontal search pattern on visual arrays that use letters, numbers or words, some typical adults may use a vertical strategy.[259] As long as the client completes the subtest with acceptable accuracy, use of a vertical strategy is considered an effective strategy.

The client initially misses a target but locates it when checking their work. Rechecking work to locate missed targets on a cancellation test is observed in typical adults.[259] It occurs more often on subtests that demand greater attention-those with crowded or random arrays (*single letter search-crowded, word search, structured complex circles search, random complex circles search*). Older adults more frequently recheck their work than younger adults.[259]

The client is unable to cross out the target accurately and places the mark to one side of the target. This does not suggest reduced visual attention but may indicate reduced eye-hand coordination due to poor acuity, hemianopia, diplopia, or other oculomotor impairment.

The client slowly but accurately completes the subtest using a structured search strategy. This may indicate a general slowness in processing speed, a language deficit such as aphasia, a visual field deficit, or reduced acuity. The observation that the client used effective search strategies and was able to sustain attention to complete the subtest shows a strength in visual attention.

The client uses the fingers of the non-dominant hand to maintain their place and guide their search across the line as they cancel targets. Use of this strategy suggests that the client has a hemianopia that is affecting the fovea. Persons with hemianopia must alter their search strategy to compensate for the vision loss. Unless the client also has neglect, you should observe a left-to-right reading search strategy on subtests with structured visual arrays (*letter searches, words search, complex circle search*). Using this strategy improves accuracy BUT it also increases search time which can cause fatigue.

4.4.3.2   Key Observations on the Design Copy Test

Clients with right hemisphere brain injury may experience representational neglect-a condition where the left half of space (and often body) is not represented on the spatial maps that guide visual search disrupting the person's concept of space.[255] Design copy taps into the clients' ability to conceptualize space and plan actions. Research has identified two distinct drawing characteristics that are strongly associated with left neglect: 1) omitting details on the left side of the drawing and 2) expansion and/or elaboration of details on the left or right side of the drawing due to perseveration.[43, 190, 193] There is no consensus yet on the underlying cause of these behaviors, but omissions are attributed to difficulty exploring left space and perseveration is attributed to inability to plan and monitor performance.[193]

The client draws half of the house, flower or clock. (Figure 4.4.2. example F). This strongly suggests neglect [244] especially when the client shows the same left sided omission of targets on the visual search subtests, has difficulty attending to items on left side, and difficulty incorporating the left extremities into ADLS and maneuvering a wheelchair. The Catherine Bergego Scale (see section 4.5.5.2 and Appendix D) is a good follow up assessment to use.

When copying the clock, the client draws a circle but numbers only half of the clock. (Figure 4.4.2 examples B and G). The client may be able to draw a complete circle because the circle is a well-established perceptual construct but is unable to number the clock on the left side because of an inability to move into that space due to neglect.[43] It is unlikely that a client with only a left hemianopia will make this mistake because they can access an internal representation of this object. But the client with neglect may not be able to access a completed representation of the clock.

The client omits details on the left side of the drawing. Omission of details on the left side is a strong indicator of neglect. Omitting 1-2 petals on the flower or a single leaf (Figure 4.4.2, example A) suggests mild neglect. Leaving off the entire left half of the house (example F) or all of the numbers on the left side of the clock (example B) suggests neglect.

The client elongates details on the right side of the drawing or skews the drawing towards the right side. Elongation of details on the right side (the pedal in Figure 4.4.2, example C) suggests graphic perseveration-a behavior associated with neglect.[43, 188]

The client initially draws an incomplete or half drawing, then attempts to correct the drawing after viewing it. (Figure 4.4.2 example E). Recognizing that the drawing is incomplete suggests that client has at least some ability to conceptualize left space.[115] A client with mild neglect or a left hemianopia would have the attentional capability to attempt to correct the drawing. The addition of the second window on the left side of example E may suggest perseveration.

T*he client drawing is simplistic-symmetrically lacking details.* Simple drawings that omit details on both sides of a figure (Figure 4.4.2 example D) are associated with left hemisphere injuries and aphasia and may partially reflect a challenge in planning movement.[41]

The client elaborates the drawing adding extra detail*s.* This may occur on either the left or right side of the drawing when, for example, the client adds a or sun or curtains to the drawing of a house. Research has suggested that it is a perseverative behavior associated with neglect and most often observed in right hemisphere injuries.[188, 189]

The client leaves out tiny details such as a loop on the smoke or the dot in the center of the hands on the clock. These are not considered errors if the primary details (e.g., the smoke, the house, and the hands on the clock) are present and accurately depicted.

The client unsuccessfully attempts to correct drawing. Figure 4.4.2 examples E and G. The client's attempt to correct the drawing suggests some ability to conceptualize space but their lack of success also suggests difficulty conceptualizing space.

The client's performance improves in response to cuing. This is an important observation because it shows that the client can modify attention to improve performance. Persons with only primary sensory loss (hemianopia) possess this capability but persons with neglect lack it.

The client does not respond to cues to improve performance. This is an important observation because it shows that the client is unable to use attention to improve performance. Most persons with hemianopia possess this capability but persons with neglect lack it.

Figure 4.4.2   Examples of Client Design Copy Performance
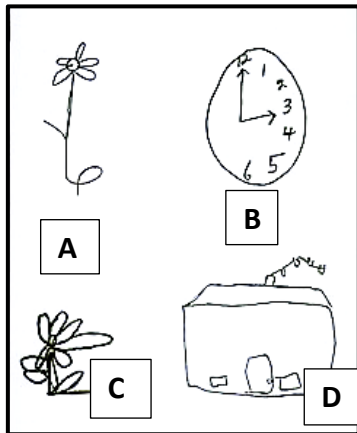
A: Omits details on left side.
B. Half numbering-omits details on left side.
C. Elongation of details towards the right side.
D. Simplistic; symmetrically omits details in the drawing.
E. Client drew half of house (right side) then added the second half (left side) with elaboration.
F. Half drawing.
G. Client began numbering clock on the right side and was unable to move leftward; tried again to number the left side beginning with number 7 but moved rightward to avoid moving into left space.