Objective. In this correlational study of adults receiving occupational therapy who sustained a cerebrovascular accident (CVA), the relationship between basic visual functions (including acuity, visual field deficits, oculomotor skills, and visual attention or scanning) and higher level visual-perceptual processing skills (e.g., visual closure and figure–ground discrimination) was investigated.

Method. Thirty adults who sustained CVA and 20 adults without a history of CVA were given a basic visual function screening and the Motor-Free Visual Perception Test (MVPT). Scores on the vision screening and the MVPT were correlated statistically.

Results. A Pearson product-moment correlation analysis produced a correlation of \( r = .75 \) between vision screening scores and scores from the MVPT.

Conclusion. These results suggest that a positive relation exists between basic visual functions and visual-perceptual processing skills. Further, the results suggest that evaluation of visual-perceptual processing skills must begin with assessment of basic visual functions so that the influence of these basic visual functions on performance in more complex tests can be taken into consideration.


After sustaining a brain injury, a person is often left with varying degrees of cognitive and perceptual dysfunction as well as the more obvious motor and sensory deficits (Quintana, 1995). Visual function is an important concern after a brain injury because vision is vulnerable to central nervous system injury (Gianutsos, 1997; Simon, Aminoff, & Greenberg, 1989). Visual-perceptual processing deficits have been found to be significantly related to independence in self-care and discharge disposition (Bernspång, Viitanen, & Eriksson, 1989; Carter, Oliveira, Duponte, & Lynch, 1988; Kaplan & Hier, 1982; Lorenze & Cancro, 1962; Mitcham, 1982; Sea, Henderson, & Cermak, 1993; Strano, 1993; Titus, Gall, Yerxa, Robertson, & Mack, 1991; Warren, 1981). Thus, occupational therapists routinely evaluate and intervene to restore cognitive and perceptual skills in persons with brain injury as prerequisites to the overall goal of promoting achievement of optimal functional independence (Quintana, 1995).

Although the important role that visual perception plays in the performance of functional activities has been documented, the extent of methods by which occupational therapists evaluate visual-perceptual processing skills of the person with brain injury is controversial. The evaluation of visual-perceptual processing skills is often limited to
the use of two-dimensional visual-perceptual tests that provide a measure of visual-perceptual skills such as spatial relations, visual discrimination, and figure–ground perception (Toglia, 1989, 1992; Tsurumi & Todd, 1997; Warren, 1994). This evaluation does not routinely screen for deficits in the basic visual functions, such as visual acuity and visual field integrity, that could influence performance on a two-dimensional visual-perceptual test. The primary purpose of the current study was to compare the performance of persons who had sustained cerebrovascular accidents (CVA) on a vision screening of the basic visual functions and a traditional two-dimensional visual-perceptual test, to determine whether a relationship exists between the two.

Literature Review

Occupational therapists have taken a leading role in bringing visual problems after brain injury into focus as an intervention issue. During the past decade, occupational therapists have made great strides in the screening and treatment of visual disorders in persons with acquired brain injury (Aloisio, 1998; Gianutsos, 1997). However, the validity and usefulness of the traditional testing methods used to assess visual-perceptual processing have been questioned. Traditionally, clinicians have limited testing of visual-perceptual processing to the use of visual-perceptual tests that originally were developed by psychologists with the intent of identifying deficits in discrete skills, such as visual closure, figure–ground discrimination, and form constancy (Toglia, 1989, 1992; Tsurumi, & Todd, 1997; Warren, 1994). This approach is referred to as skill specific or deficit specific, and its purpose is to identify perceptual deficits; treatment of the deficient performance is not emphasized (Abreu & Toglia, 1987; Toglia, 1989). Much of the research on ‘visual perception’ has been done using two-dimensional representations such as paper-and-pencil tests or shape identifications on paper, and much of the literature has failed to acknowledge the role of basic visual functions in any way (Tsurumi & Todd, 1997). As a result, good visual perception often is understood only to correlate with the ability to achieve a passing score on tests that use two-dimensional representations, such as the commonly used Motor-Free Visual Perception Test (MVPT; Colarusso & Hammil, 1972).

Several limitations have been identified and reported in the literature regarding the traditional approach of assessing visual-perceptual processing skills. Farber and Abreu (1993) state that the traditional approach reinforces the assumption that visual-perceptual abilities are viewed as higher level cortical functions, which can be divided into separate subskills, such as spatial relations, figure–ground perception, and visual memory. Furthermore, occupational therapists who limit their testing to using the traditional tests often assume that only the higher level cortical functions contribute to visual-perceptual processing.

Some authors (Aloisio, 1998; Bouska, Kauffman, & Marcus, 1985; Gianutsos, 1997; Hellerstein & Fishman, 1997; Siev, Freishtat, & Zoltan, 1986; Strano, 1993; Tsurumi & Todd, 1997; Warren, 1993a, 1993b, 1994) have proposed that the traditional approach of testing for visual-perceptual impairments should be abandoned in favor of an approach that emphasizes the process of visual integration and the relationship between the levels of visual-perceptual processing. These authors have suggested that the evaluation of visual-perceptual processing begin with assessment of visual foundation skills or basic visual functions—including visual acuity, visual field integrity, oculomotor skills, and visual attention and scanning—so that their influence on performance can be ruled out (Gianutsos, 1997; Gianutsos & Matheson, 1987; Warren, 1990, 1994). Likewise, the authors agreed that it is not the occupational therapist’s role to perform an extensive eye examination, but to complete a clinical screening of gross visual function. A vision screening is essential to the interpretation of visual-perceptual and cognitive deficits. This approach would require a change in the current evaluation procedures, requiring that visual foundation skills such as acuity be screened in addition to the administration of traditional visual-perceptual tests to determine their potential influence on test results.

Warren (1994) developed a framework of visual-perceptual processing that suggests that higher level skills (visuocognition, visual memory, pattern recognition) result from the integration of lower level skills (visual acuity, visual field, oculomotor control) and are subsequently affected by disruption of lower level skills. This framework is consistent with the information processing approach to evaluation of cognitive and perceptual deficits that has been advocated by Abreu and Toglia (1987) and Toglia (1989). Aloisio (1998) clarified that lower level skills or basic visual functions are the most basic and functional visual skills necessary for the development and management of all visual perception and visual motor activities. Additionally, these skills must be intact for the person to receive, process, interpret, and respond appropriately to input from the environment.

Basic visual functions include visual acuity, visual fields, and oculomotor control. Visual acuity is the ability to see small detail near and far. Visual acuity is measured using conventional high-contrast (black-on-white) letter charts by determining the smallest high-contrast detail that a person can perceive at a given distance. Deficits in visual acuity due to brain injuries have been reported in the literature (Simon, Aminoff, & Greenberg, 1989). Contrast sensitivity function (CSF), which measures low-contrast acuity, has been advocated as a more functional evaluation of acuity (Gianutsos & Matheson, 1987; Warren, 1993a, 1993b). CSF is the ability to reliably detect the borders of objects as they degrade in contrast from their backgrounds, making it possible to distinguish and identify faint objects (Hyvarinen, 1994). Several authors have reported that CSF...
may be impaired in persons who do well on the traditional high-contrast acuity letter chart (Bodis-Wollner & Diamond, 1976; Bulens, Meerwaldt, Van der Wildt, & Keemink, 1989). Persons with cerebral lesions have also been found to show deficits in CSF (Bodis-Wollner & Diamond, 1976; Bulens et al., 1989; Hess, & Pointer, 1989). Reduced CSF has been related to the normal aging process as well (Owsley, Sekuler, & Seimsen, 1983).

The visual field is the field of view of the external world seen by the two eyes without movement of the head (Kelly, 1985). Deficits in visual field have been associated with CVA and traumatic brain injury (TBI) (Gianutsos, 1997; Gianutsos & Suchoff, 1997; Warren, 1981; Zihl, 1994). Identification of visual field deficits has traditionally been determined by use of a confrontation test (Gianutsos & Matheson, 1987; Warren, 1993a, 1993b). However, it has been reported that confrontation techniques used to identify visual field deficits overlooked at least 50% of the hemianoptic deficits in a group of patients, suggesting that this form of testing is insensitive and only helpful with detecting gross deficits (Trobe, Acosta, Krischer, & Trick, 1981).

Oculomotor function is the ability to move the eyes together precisely to maintain binocular vision. If the eyes are misaligned, which may be caused by abnormalities of muscle or nerve, double vision (diplopia) occurs (Gouras, 1985). Binocular vision problems are common in adults and children who have had CVA or TBI (Scheiman, 1997). A screening of oculomotor function typically includes eye alignment, convergence, and pursuit.

Visual scanning is a motor function and, as such, must be driven by a sensory process. The sensory process controlling visual scanning is selective visual attention. During visual scanning, the eye movements observed reflect the engagement of visual attention as it is shifted from object to object (Warren, 1994; Posner & Rafal, 1987). Studies have shown that disruption in the normal scanning strategy can occur after brain injury (Belleza, Rappaport, Hopkins, & Hall, 1979; Chedru, Leblanc, & Lhermitte, 1973; Gianutsos & Matheson, 1987; Posner & Rafal, 1987; Tyler, 1969). Research has shown that scanning tends to be unsystematic and irregular after brain injury and that adoption of these strategies will result in impaired performance in activities requiring thorough attention and scanning (Gianutsos & Matheson, 1987). Tests used to measure attention and scanning allow the examiner to clearly observe the process by which the person completes the tasks, such as letter cancellation and line bisection paper-and-pencil tests.

Few studies have explored the relationship between the basic visual functions and the higher level visual-perceptual processing. Locher and Bigelow (1983) observed eye movements of adult persons who had sustained a CVA and non-impaired control participants as they viewed selected cards on the MVPT. Locher and Bigelow's study is one of the few that takes into consideration that a person may show dysfunction in the basic visual functions and that this dysfunction may affect the performance on a test assessing the higher level visual-perceptual processing such as that assessed with the MVPT. Eye movements of adult persons with CVA and 11 control participants without neurological impairment were recorded as they viewed selected cards of the MVPT. One of the study's findings was that the scanning strategies of the group with CVA were unsystematic and irregular. In addition, the group of impaired participants scanned the cards longer and made more errors than control participants. Locher and Bigelow concluded that the MVPT was an appropriate measure for general assessment of visual-perceptual skills only in adults with brain injury without severe clinical manifestations of neglect because those with neglect symptoms made more errors on the MVPT, possibly because of their scanning deficits.

Based on the information provided by the most recent literature, occupational therapists may need to modify the methods used to evaluate visual-perceptual skills. The purpose of this study was to investigate the relationship between the status of basic visual functions (visual acuity, visual field integrity, oculomotor control, and scanning and attention skills) and the higher level visual-perceptual processing as measured by the MVPT. It was hypothesized that there would be a positive correlation between performance on the vision screening and performance on the MVPT. That is, participants who scored low on the vision screening, would also score low on the MVPT, and those who scored high on the vision screening would exhibit high performance scores on the MVPT.

**Method**

**Participants**

**Pilot testing.** To establish interrater reliability on the vision screening, 18 participants who had no history of brain injury, psychiatric illness, or major vision problems (defined as corrected visual acuity less than 20/50 or a visual field of 20° in diameter or less) were recruited to participate as volunteers from a college campus. They ranged from 21 to 41 years of age (M = 26.33, SD = 5.95). The primary investigator and three additional data collectors scored participants on the vision screening. Interrater reliability of the vision screening was established by having each participant's performance scored independently but simultaneously by the primary investigator and one data collector. Three separate Pearson product-moment correlations between testers ranged from 0.92 –1.00.

Fifty adults made up the study sample. Thirty adults (11 men and 19 women) who had sustained CVA and who were receiving occupational therapy services in two hospitals in the Kansas City metropolitan area made up the experimental group. Occupational therapists in the participating hospitals contacted the primary investigator when they received a referral for a person with a CVA. All potential participants were screened via questionnaire and med-
ical chart review for the following inclusion criteria: primary diagnosis for admission to the rehabilitation unit was the occurrence of a CVA, time after CVA no longer than 6 months, native English language speaker, no history of previous CVA or psychiatric condition, no pre-morbid history of severe vision problems as defined in the preceding paragraph, and intact cognition (score of 18 or higher) in the Foslstein Mini Mental State (Folstein, Folstein, & McHugh, 1974). Participants with reading acuity worse than 20/400 and between 20/60 to 20/160 were excluded from the study to keep the sample of participants from performing on the extremes of the basic visual skills. All participants were given printed informed consent forms. Participants’ ages ranged from 26 to 86 years (M = 58.7, SD = 13.43). Time after injury ranged from 1 to 12 weeks (M = 4.25, SD = 3.49). Educational level ranged from 8 to 18 years of school (M = 13.13, SD = 2.36). Sixteen participants sustained right hemisphere CVAs, and 12 sustained left hemisphere CVAs. One person sustained infarcts in the cerebellum and pons, and one other person sustained a basal ganglia CVA.

The 20 participants (6 men and 14 women) in the control group were matched as a group to the experimental group for gender and within 2 years in age and educational level. Participants were recruited on a voluntary basis from a community senior center in the Kansas City metropolitan area. Potential participants were screened via questionnaire by the primary investigator for the following inclusion criteria: no history of neurological impairment, psychiatric conditions, or pre-morbid history of vision problems as defined previously. All control group participants were native English speakers, and all were given printed informed-consent forms. Persons in the control group ranged in age from 28 to 77 years (M = 60.05, SD = 14.93) and ranged in educational level from 10 to 16 years of education (M = 13.5, SD = 1.54).

Instruments

The experimental and control group participants were given a brief questionnaire designed to obtain demographic information and to inquire about any deficits or complaints about their current visual status. Completion of the questionnaire was followed by administration of the basic visual skills screening battery and the MVPT.

The basic visual skills screening battery assessed the following areas: visual acuity, visual field integrity, oculomotor function, and visual scanning and attention. The testing battery was selected on the basis of its established reliability, portability, and short administration time. Performance on each test was evaluated on a 2-point scale (1 = impairment, 2 = no impairment). (Information on the basic visual skills screening battery may be obtained from the first author.) Distance acuity was not tested because the MVPT requires only near reading visual acuity. Due to experimenter error, the star cancellation test was omitted for 3 participants from the experimental group. The scores on each of the basic visual function tests were added, which gave a total possible score on the vision screening of 32. The scores of the participants in the inter-rater reliability phase (pilot testing) were used to establish the limits of normal performance on the vision screening. A score of 30 out of a maximum of 32 was determined as the cutoff score to denote impairment. This was a conservative cutoff score because the reliability participants ranged from 21 to 41 years of age, whereas the study participants were typically older. Thus, vision screening cutoff would capture those who may have visual impairment due to the aging process. This cutoff score was established to separate participants who scored within normal range in the vision screening from those who had more than one basic visual function deficit area.

To assess the presence of higher level visual-perceptual deficits, each participant completed the MVPT (Colarusso & Hammill, 1972). The MVPT was selected because it is commonly used by occupational therapists to identify visual-perceptual dysfunction. The MVPT, which was originally designed for children, measures spatial relations, visual discrimination, figure-ground perception, visual closure, and visual memory. The test is a 36-item, two-dimensional, multiple-choice test designed to evaluate visual perception as a whole. Participants are asked to point to one of the four alternatives that he or she feels is the correct response. Standardized procedures were followed according to the manual. A cutoff score of 33, from a total score of 36, was used to denote impairment. The score on this test gives an overall measure of visual perception and is not meant to be differentiated into the various areas tested.

Procedure

Testing was completed in sessions ranging from 45 min to 2 hr in length. All testing took place individually in quiet rooms with adequate ambient lighting. Before testing, all participants were given informed consent forms and were instructed regarding the procedures of testing. They were also tested with corrected vision if applicable.

Each participant was given a questionnaire, followed by the vision screening and the MVPT. One total score was obtained from the vision screening and the MVPT. Three occupational therapy students and one registered occupational therapist administered the tests. The data were analyzed with the Statistical Package for the Social Sciences (SPSS).

Results

Vision Screening

Performance on the vision screening was statistically signifi-
significantly lower for the sample of participants with CVA than the performance of the control sample group, $t(48) = -3.840, p < .001$. Fifteen of the 30 persons in the group with CVA scored below the cutoff score on the vision screening. Within this sample, 9 had right hemisphere CVAs, 4 had left hemisphere CVAs, 1 had CVA in the cerebellum and pons, and 1 had CVA in the basal ganglia. The most commonly impaired basic visual skills listed in order of frequency were: scanning and attention (15 out of 15 participants); oculomotor and visual field deficits (10 out of 15 participants); and contrast sensitivity (7 out of 15 participants). The least commonly impaired basic visual skill was reading acuity (1 out of 15). Of the 15 persons scoring below the cutoff on the vision screening, 10 reported having noticed some changes in their vision since the onset of the CVA. Five reported no changes in their vision.

Twenty-three of the 30 participants showed impaired performance on at least one test of the vision screening. Eight of the 23 persons did not report noticing changes in their vision, whereas 15 of the 23 persons reported noticing vision changes since the onset of CVA. Table 1 shows the basic visual functions most frequently affected. Regarding visual field deficits, left visual field deficits were more common than right visual field deficits. Participants who sustained a right CVA showed more visual field deficits when compared with those who had sustained a left CVA. Two participants had other CVA sites, and both showed scores below the cutoff.

When data from the sample of matched controls were examined, only 2 out of the 20 participants scored below the cutoff score in the vision screening. Of the two persons with scores below the cutoff, deficits in their right and left visual fields deficits and reduced contrast sensitivity function were noted. Table 1 shows the most frequently affected basic visual functions and compares them with the CVA group. Contrast sensitivity function was the most commonly impaired basic visual function in the control group, with a total of 7 out of the 20 persons with deficient performance on this test. Deficits in the left visual field were present in 3 of the 20 participants, and deficits in the right visual field were present in 2 persons who also had a left visual field deficit.

Scanning and attention deficits were noted in 1 participant. All 9 control participants showing deficits in basic visual functions wore prescription glasses for reading, but did not report being aware of any visual changes or deficits.

**Performance on the MVPT**

The CVA sample also showed significantly lower performance scores on the MVPT than the control group, $t(48) = -4.809, p < .001$. Fourteen of the 30 persons in the CVA group scored below the cutoff score in the MVPT and below the cutoff score in the vision screening. Six more persons in the CVA group scored below the cutoff in the MVPT, but not the vision screening; however, 4 of the 6 showed at least one deficit area on the vision screening (2 persons showed poor contrast sensitivity function, 1 showed poor contrast sensitivity function and oculomotor deficits, and 1 showed poor oculomotor skills). Only 1 participant scored below the cutoff on the vision screening and above the cutoff on the MVPT.

To investigate whether a relationship exists between the time of testing after injury and performance on the vision screening and the MVPT, separate Pearson product-moment correlation analyses were computed between time of testing for the CVA group and total scores on the vision screening and MVPT. The time after injury was the number of weeks between the date when the CVA was diagnosed and the date of the vision screening. No significant correlation was found between the time of diagnosis of the CVA and the scores of the visual screening, ($r = .29, p = .11$). No relationship was found between performance in the vision screening and the time after injury when the participants were tested. Persons with CVA who were tested earlier in their recovery performed similarly to those tested later in their recovery. However, a significant correlation was found between the time of diagnosis of the CVA and the MVPT scores ($r = .38, p = .03$) in that performance on the MVPT seemed somewhat related to the time after injury when testing took place, with participants scoring slightly lower in the MVPT during the earlier weeks after their CVA.

Regarding performance in the MVPT, only 2 participants showed scores below the cutoff. Both of these control participants had scores higher than the cutoff on the vision screening, with 1 of the participants showing a poor contrast sensitivity score.

**Basic Visual Skills and MVPT Relationship**

To investigate the relationship between basic visual functions and higher level visual-perceptual skills, the total raw scores on the vision screening and the MVPT scores for all 50 participants were transformed into total percent scores, and these percent scores were correlated using the Pearson product-moment correlation analysis. Total percent scores were used to include the scores of the 3 participants with CVA who did not complete the star cancellation test. A statistically significant correlation ($r = .75, p < .001$) was found

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**Table 1**

**Number of Participants With Impaired Basic Visual Skills for Each Sample Group**

<table>
<thead>
<tr>
<th>Basic Visual Skills</th>
<th>Sample Groups</th>
<th>CVA* (%)</th>
<th>Control** (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual scanning and attention</td>
<td>17 (57)</td>
<td>1 (5)</td>
<td></td>
</tr>
<tr>
<td>Oculomotor skills</td>
<td>12 (40)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Contrast sensitivity</td>
<td>11 (37)</td>
<td>7 (25)</td>
<td></td>
</tr>
<tr>
<td>Visual field deficits</td>
<td>10 (33)</td>
<td>3 (15)</td>
<td></td>
</tr>
<tr>
<td>Reading acuity</td>
<td>1 (3)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Showed deficit in at least one area of vision screening</td>
<td>23 (77)</td>
<td>9 (45)</td>
<td></td>
</tr>
</tbody>
</table>

*($n = 30$) **($n = 20$)

*Note. CVA = cardiovascular accident.*
between the score on the vision screening and scores on the MVPT. This correlation is represented in Figure 1. A Pearson product-moment correlation analysis was also computed without the same 3 participants with CVA, and a significant correlation was found \(r = .74, p < .001\).

**Discussion**

The results of this study suggest that there is a relationship between basic visual functions (including reading acuity, visual field integrity, oculomotor skills, and visual scanning and attention), and higher level visual-perceptual skills (such as visual spatial relations, visual discrimination, figure–ground, visual closure, and visual memory) as measured by the MVPT in persons who sustain brain injury due to CVA. Twenty-three of the 30 participants (77%) in the post-CVA sample showed impairment in at least one basic visual function. Most of the persons with low performance on the vision screening also performed poorly in the traditional visual-perceptual assessment (MVPT) used in this study.

The results of this study suggest that, when evaluating visual-perceptual processing skills in persons who sustain CVA, clinicians must start with a screening of the basic visual functions. Additionally, the traditional approach of testing only higher level visual-perceptual skills should be abandoned, as has been proposed by many authors (Aloisio, 1998; Bouska, Kauffman, & Marcus, 1985; Gianutsos, 1997; Hellerstein & Fishman, 1997; Siev, Freishtat, & Zoltan, 1986; Strano, 1993; Tsurumi & Todd, 1997; Warren, 1993a, 1993b, 1994). Participants in this study who showed the lowest scores in the MVPT had the most pronounced impairment on the vision screening. Thus, low scores on a traditional visual-perceptual test alone do not provide clinicians with important information necessary to help persons regain complex visual functions and the information needed to help the person adapt to his or her condition.

Figure 1. Positive correlation \(r = .75, p < .001\) between percentage scores in the MVPT and vision screening for persons with and without cerebrovascular accident \(n = 50\). As scores in the vision screening increase, scores in the MVPT also increase.

Considering the scores on the tests in the vision screening separately, all but one of the participants with CVA who scored below the cutoff score on the MVPT performed poorly in the scanning and attention tests of the vision screening, which implies that persons with poor visual scanning and attention are likely to perform poorly in the MVPT. These results are consistent with those reported by Locher and Bigelow (1983). Diller and Weinberg (1970) also reported that persons with right CVA showed decreased scanning and attention on the Digits Cancellation Task (a test that requires the subject to cancel out specific digits [43] in a group of digits) and also were more likely to experience injuries due to falls and to have increased difficulty in completing ADL than did those with left CVA. Warren (1990) also reported that deficits in visual scanning were found in post-CVA participants. If clinicians use a vision screening that identifies visual scanning and attention difficulties, they may be able to determine that these persons do not visually scan their environments effectively and may be at increased risk for falls and possible injury. With knowledge of basic visual scanning and attention, the clinician can develop a treatment intervention to address this deficit.

Limitations in oculomotor skills and visual fields also presented as common factors in 9 of the participants with low MVPT scores, suggesting again that the deficit reflected in the low MVPT score may be influenced by impairment of basic visual functions. The results of this study are consistent with other studies that have found eye movement problems to be common secondary to brain injury (Baker & Epstein, 1991; Slagerter, Gray, & Hall, 1993; Warren, 1990).

In 1997, Gianutsos reported that “people with TBI are likely to have accommodative problems, binocular dysfunction, and eye movement dysfunctions, while people after having a CVA are more likely to experience losses in the field of vision” (p. 272). Likewise, Warren (1981) reported a study in which the presence of visual field deficits was found to be present in participants who have sustained a CVA. The results of this study confirm the high incidence of visual field deficits in persons who sustain CVA. Because of this finding, it is important for clinicians to screen for deficits in this area because safety of the person may be at risk if deficits are not addressed early in the intervention process. This safety factor is worsened by the fact that many persons with visual impairment are not aware of any deficits. Levine (1990) and Gianutsos (1997) found that it is common for persons who sustain brain injury to be unaware of deficits in vision even with deficits as significant as hemianopsia (vision loss in half of the visual field of each eye) (Levine, 1990). The results of this study lend some support to this theory, 15 of the 23 participants with basic visual function deficits reported being aware of problems with their vision, whereas 8 of the 23 did not report any problems with their vision. Gianutsos (1997)
suggested that vision guides other sensory input, and, in
many cases, the brain will ignore and modify faulty visual
input to maintain order in the sensory system. Levine
(1990), however, wrote that hemianopsias are difficult to
discover because several mechanisms automatically com-
penstate for the defect. These compensatory mechanisms
may result in the person not complaining of deficits or
seeking help, even when visual deficits are present. Thus,
because of the safety implications secondary to a lack of
awareness, it is important for occupational therapy practi-
 tioners to screen for vision problems even if the consumer
denies any deficits. Through the use of screening tools,
occupational therapy practitioners can make persons who
have sustained a CVA aware of visual field deficits, thus
increasing the person's understanding of the need to use
compensatory interventions, such as turning the head to
scan the environment more effectively.

In the control group, all but two persons scored above
the cutoff score on the vision screening despite the fact that
the cutoff score was determined by the performance of a
younger group on the vision screening. Contrast sensitivity
function was the most common deficit observed on the
visual screening. None of the control participants reported
having any problems with their vision. The high incidence
of contrast sensitivity function deficits may be explained by
the fact that contrast sensitivity function may decrease with
increasing age (Owsley et al., 1983). Faye (1997) stated
that the normal aging process reduces an adult's ability to
discern the contrast of objects against a background. It is
possible that this decline in contrast sensitivity function
may be a gradual process with increasing age, for which a
person learns to compensate; thus, the person is not aware
of any vision changes. Other deficits noted in the control
group included right and left visual field deficits, and scan-
ning and attention deficits. A formal eye exam was recom-
mended for both participants who scored below the cutoff
score on the vision screening.

Limitations and Directions for Future Research
One limitation of the study is that participants in the group
with CVA were not recruited consecutively. Rather, we
relied on occupational therapists in the participating hospi-
tals to call the primary investigator when there was a poten-
tial participant with CVA at their facility. It may be that
only the people with more severe CVAs were referred to us.
That, combined with our relatively small size, may mean
that our sample is not representative of the total population
of persons with CVA. Nonetheless, the results suggest that,
at least, for some persons with CVA who are experiencing
basic visual skills impairments, test results of visual-percep-
tual processing alone (e.g., the MVPT) will not inform the
intervention team regarding the impairments the person is
experiencing at the basic visual skill level.

Another limitation is the fact that, to test visual per-
ception, this study used the MVPT, a test that was designed
to assess visual perception in children. Although the
MVPT was used to evaluate older adults in the Locher and
Bigelow (1983) study, it is suggested that future studies use
the adapted version of the MVPT. The adapted version is
intended to be used with older adults who sustain brain
injury and has been standardized on a normal adult popu-
lation (Bouska & Kwatny, 1983).

Finally, this study examined the relationship between
two vision impairments rather than between these impair-
ments and the person's level of function. It will be impor-
tant for future research to determine how closely related
basic visual function impairments are to the ability to com-
plete desired activities. Providing a sound empirical basis
for such a relationship would give a strong rationale for
practitioners performing vision screenings. If it is found,
however, that vision impairments and function are unrelat-
ed, one should question the rationale for practitioners to be
performing vision screenings.

Conclusions
The processing of visual information is a complex function
that should be screened and evaluated by one or more
members of the rehabilitation team, including the occupa-
tional therapy practitioner. The results of this study suggest
that practitioners screen for visual acuity, contrast sensitiv-
ity function, visual field, ocular motor function, and visual
scanning and attention before evaluating higher level visu-
al processing. If the screening results indicate deficits in any
of the basic visual functions, referral to ophthalmology or
optometry is needed. In addition, if deficits are noted,
modification of test procedures should be made if a test of
higher level visual perception is given, such as moving the
testing material out farther for a person with convergence
insufficiency or increasing the ambient and task lighting
for a person with decreased contrast sensitivity function.

Specialists in ophthalmology and optometry tradition-
ally have not been part of brain injury rehabilitation teams;
however, the current study provides some preliminary data
showing the prevalence of basic visual function deficits in
persons undergoing rehabilitation secondary to CVA. The
need to establish relationships with these eye care specialists
and to include them as members of the rehabilitation teams
serving persons with acquired brain injury appears to be
justified. Occupational therapy practitioners without access
to eye care professionals on a rehabilitation team need to
find competent professionals within their communities to
refer consumers to when vision problems are identified
through vision screenings.

This study has focused on the importance of screening
for deficits in basic visual functions when working with
persons with acquired brain injury from CVA. The results
of this study support the growing opinion within the field
of occupational therapy that traditional visual-perceptual
tests performed alone are not best practice. When tradi-
tional tests are accompanied by a basic visual function
screening such as the one used in this study, information is obtained that can be relevant and useful when interpreting other evaluations administered to the client. The process of educating the person and caregivers regarding the status of the person's visual system can be initiated after results from a vision screening are completed. Gianutsos (1997) stated that persons with acquired brain injury often undergo comprehensive rehabilitation with numerous occupational performance deficits caused by untreated basic visual function deficits, and that one can only speculate how much more quickly persons with identified basic visual function deficits would complete their therapies if their visual dysfunction was recognized and treated earlier. In addition, relevant vision issues may then be addressed within the occupational performance of the person.

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