Perceptual Retraining for Adults With Diffuse Brain Injury

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Occupational therapy for adults with perceptual dysfunction secondary to diffuse acquired brain injury from trauma or anoxia often includes remedial retraining with treatment tasks, like construction of puzzles, to provide clients with practice in deficit perceptual skills. Therapists using this approach assume that adults with brain injury learn specific perceptual skills from retraining exercises and can transfer those skills across all activities (including self-care and community living activities) that require those skills. This review of outcome studies about remedial perceptual retraining for adults with diffuse acquired brain injury suggests that those learning assumptions hold true only for clients with localized lesions and preserved abstract reasoning who have been explicitly taught to transfer learning across a variety of treatment activities. Recommendations about ways to assess clients' learning potential and appropriateness for remedial retraining include keeping track of the number of repetitions clients need to relearn functional tasks and systematically varying functional tasks during training to see how easily clients can transfer learning across variations of the same task.

Because perceptual deficits are common in adults with diffuse acquired brain injury secondary to trauma or anoxia, occupational therapists working with this population often focus on improving the perceptual components of occupational behavior. Many therapists follow a remedial perceptual retraining approach for this aspect of treatment (Holzer, Stiassny, Sener-Hurley, & Lefkowitz, 1982; Hopkins & Smith, 1988; Prigatano, 1986; Trombly, 1989; Van Deusen, 1988; Wahlstrom, 1983; Zoltan, Siev, & Freistat, 1986). Remedial perceptual retraining involves using treatment tasks like construction of puzzles to give clients practice in impaired perceptual skills that contribute to poor functional performance (Anderson & Choy, 1970; Gregory & Aitken, 1971; Holzer et al., 1982; Neistadt, 1990; Wahlstrom, 1983).

Therapist teaching and client learning are inherent in perceptual retraining, but occupational therapists have only recently begun to explicitly analyze these treatment procedures from a learning theory perspective (Neistadt, 1990; Toglia, 1991; Warren, 1993). Analyzing perceptual retraining as learning can yield insights into more effective ways to structure this type of treatment and more precise ways to identify clients who might benefit from it. Therapists using a remedial approach to perceptual retraining make two assumptions about learning: (a) tabletop activities like puzzle construction provide training in the perceptual skills underlying performance on those activities, and (b) clients will transfer those perceptual skills across all activities requiring those skills. If these assumptions are valid, clients working with remedial activities will learn more effective perceptual processing, not just splinter skills (sequences of motor patterns specific to particular activities). Furthermore, clients will use their improved perceptual processing in all activities to which that processing applies. Consequently, improved performance in perceptual retraining tasks, like puzzle assembly, should be paralleled by improved performance in functional activities, like dressing or driving (Neistadt, 1990; Zoltan et al., 1986).

Relatively few studies have been done to examine the effectiveness of remedial perceptual retraining in improving functional performance for adults with diffuse acquired brain injury secondary to trauma or anoxia. Although most of these studies were not explicitly designed to test learning theory, all of them implicitly test the learning assumptions listed above. This article reviews and analyzes remedial retraining outcome studies from a learning theory perspective, to identify characteristics of clients who are most likely to benefit from remedial programs and training procedures that will foster transfer of learning from remedial retraining to functional activities. The studies reviewed were selected according to the following criteria:

- The subject population included adults with dif-
Theoretical Context – Learning Theory

Perceptual Learning as Information Processing

Learning can be defined as “a relatively permanent change in behavior or in behavior potentiality that results from experience and cannot be attributed to temporary body states induced by illness, fatigue, or drugs” (Hergen­
hanh, 1976, p. 9). Since the late 1950s, the dominant perspective in learning theory has been information pro­
cessing (Hintzman, 1978; Ormrod, 1990). The informa­
tion-processing perspective views learning as a process mediated by the brain, with the brain acting as an in­
formation-processing device similar to a computer (Kantowitz & Roediger, 1980).

In line with this body of theory, Abreu and Toglia (1987) have proposed an information-processing per­
spective on perception. According to this perspective, the perceptual process includes: (a) sensory detection, (b) analysis, (c) hypothesis formation (i.e., comparing the analysis with prior experiences and relating it to the over­
all purpose and goal of the activity), and (d) response. Responses can be either data-driven, direct responses to external stimuli, or conceptually driven, which proceed from internal expectations of incoming data.

Treatment using this perspective as a theoretical base would be “designed to ameliorate deficiencies along the continuum of the perceptual system” (p. 443) by teaching clients strategies to process perceptual information in a variety of activities and environments, with different body positions and active movement patterns. Treatment would thus promote transfer of perceptual learning across different situations.

Transfer of Learning

Toglia (1991) has suggested that therapists can facilitate client transfer of perceptual learning by varying treatment environments, varying the nature of a task (e.g., numbers, spatial arrangement, and familiarity of stimuli), helping clients become aware of the ways they process perceptual information, teaching information-processing strategies, and relating clients’ new learning to previously learned knowledge or skills. Toglia has suggested that transfer of learning must be explicitly taught and cannot be assumed to happen automatically. That is, a client who has learned a perceptual processing strategy like organized visual scanning with a tabletop puzzle task will not use that strategy during dressing unless the new scanning strategy has also been taught in the context of dressing activities. The ways in which the puzzle perceptual processing strategies can be applied to functional tasks must be explicitly demonstrated and taught during functional activity training.

Toglia (1991) has also identified degrees of transfer along a continuum from transfer to very similar to transfer to very different tasks. She suggested examining the surface characteristics of treatment and transfer tasks to deter­
mine the degree of transfer a client is making. Surface characteristics include type of stimuli (objects, letters, numbers), presentation mode (written form, auditory, or tactile modes), variable attributes (color, texture, size), stimuli arrangement (scattered, horizontal, rotated), movement requirements (sitting, standing, active move­
ment patterns), environmental context (place, people, familiarity), and the rules or directions (number of steps required).

Near transfer of learning involves transfer between tasks that are different in only one or two surface charac­
teristics. Intermediate transfer involves transfer between tasks that are different in 3 to 6 surface characteristics. Far transfer involves tasks that are conceptually similar, but have one or no surface characteristics in common. Very far transfer or generalization involves “the spontaneous application of what has been learned in treatment to everyday functioning” (Toglia, 1991, p. 508).

Transferring perceptual learning from remedial re­
training tasks like crossing out selected letters from pages of letters (letter cancellation) to functional tasks like read­ing a recipe requires intermediate transfer. Transferring perceptual learning from remedial retraining tasks like puzzle assembly to functional tasks like setting a table requires far transfer. Transferring perceptual learning from a remedial retraining tasks like puzzle construction to a functional task like grocery shopping requires very far transfer. Most functional tasks differ from remedial retraining tasks in more than three to six surface characteristics. Therefore, remedial perceptual retraining can only be effective in promoting overall functional improvements for those clients who are capable of far and very far transfer of learning.

Learning After Diffuse Brain Injury

What are the capacities of adults with acquired diffuse brain injury from head injury or anoxia for transfer of learning? Goldstein and Oakley (1985) have suggested that adults with head injury may rely most heavily on association learning, especially in the early stages of recov­
er. Association learning occurs when a person “ac­
quires some form of association between two events” (p. 14) and is mediated by subcortical or, in some cases,
and learn the perceptual processing skills associated with clients evidence from treatment activities is influenced by any diffuse) brain injuries will have less neural plasticity than older clients and those with less serious injuries. Consequently, older clients and those with severe (more diffuse) brain injuries will have less recovery of cognitive function than younger clients or those with lesser injuries. In the early stages of recovery from brain injury (i.e., within the first 6 months), it is difficult to sort out new learning from spontaneous recovery of the clients' premorbid abilities (Kertesz, 1985). Because recovery approaches premorbid cognitive skills, those clients of like age and lesions with better premorbid cognition may ultimately show better cognitive skills postinjury than those with lesser premorbid abilities (Lezak, 1983).

Relative to training characteristics, the type of transfer of learning (near, intermediate, far, very far) that any given client can make from remedial perceptual retraining to functional activities can be affected by the amount of explicit teaching for transfer in the remedial program and the amount of training time. The greater the degree of explicit teaching for transfer, the greater the likelihood that clients will be able to show intermediate, far, and very far transfer (Toglia, 1991). For clients with slowed information processing, extended training periods with much repetition are needed to promote learning and transfer of learning (Lezak, 1983).

The following section examines the client (subject) and training characteristics of perceptual retraining studies that include adults with acquired diffuse brain injury secondary to trauma or anoxia. This analysis is done in the context of Toglia's (1991) different levels of transfer of learning to see what types of learning and transfer have been demonstrated by these adults. The studies' subject and training characteristics are analyzed to see whether different types of transfer are associated with different configurations of subject and training characteristics. Subject characteristics considered are postinjury cognitive level, severity of brain injury, and stage of recovery. Subjects' ages are reported in these studies, but age is not discussed here because no conclusions can be drawn about the effects of age on training outcome from the data analyses presented. Information on subjects' premorbid cognitive levels is not reported in these studies. Training characteristics considered are length of training time and degree of explicit training for transfer (see Table 1).

Research Studies

Near Transfer

Some research has indicated that adults with head injury are able to transfer learning from perceptual retraining tasks only to very similar tasks. Miller (1980), for instance, trained both an experimental and control group on the Minnesota Spatial Relations Test, a series of four separate rectangular form boards each requiring placement of 58 different shapes. The four boards are of similar but not equal difficulty. The experimental group consisted of eight men with severe head injury, average age 23.3 years, who were 3 to 14 weeks postinjury. Control group subjects were neurologically normal and matched closely for age with the experimental group. Both groups were given five trials on each of the four form boards for 5 consecutive days. The boards were administered in a balanced order to control for the small differences in difficulty between them. The dependent measure used was the time taken, in seconds, to fit all of the pieces into a board.

Both groups showed a decrease in time scores with each successive trial on each board and in time scores on each successive board. The average time score for subjects with head injury on the first trial of the first board, for instance, was about 900 sec; the average time score on the last trial with the first board was about 500 sec; the average time score for the last trial on the last board was about 300 sec. Graphic analysis of the rates of learning of the two groups showed that the group with head injury was slower to learn than the control group. Miller concluded that his subjects with head injury showed "impressive transfer of training from one board to the next" (p. 527). The transfer of training that Miller observed, however, was near transfer between very similar tasks—form boards that varied in only one surface characteristic, that is, the forms presented within the boards. In fact, Miller's procedures would train and assess only near transfer of learning.

Ether, Banbeau, and Braun (1989), trained 19 men and 3 women with severe closed head injury on graded computer exercises for attention, visual scanning, visuo-
spatial processing, memory, auditory processing, and problem solving. Subjects ranged in age from 19 years to 50 years and in time since onset of injury from 12 months to 204 months. On average, subjects showed impaired performance on 33% of the tests in a neuropsychological battery. All subjects were given 2 hr of training per week for 6 months. Results indicated that subjects showed improved performance over time on 94% of the computer exercises, with the greatest improvements being in auditory exercises followed by memory exercises, attention, visuospatial, and problem solving exercises, in decreasing order (p. 12). Subjects were able to transfer their initial perceptual learning to progressively more difficult versions of the computer exercises, a near transfer situation. Like Miller, these investigators used procedures that trained and assessed only near transfer of learning across very similar tasks.

Robertson, Gray, and McKenzie (1988) conducted a single case study of microcomputer-based rehabilitation of visual neglect with a 20-year-old man with traumatic brain injury who was 2 months postinjury. A neuropsychological assessment before the study began indicated that this subject’s concentration and verbal memory were above the mean for his age and that he had left neglect, as demonstrated by misreading of the left halves of words, errors in design copying, and errors on a computerized test of visual scanning. Two measures were taken during four baseline sessions in the 6 days preceding the training and at the beginning of each training session. These measures were accuracy in reading word lists and accuracy in copying one design from the Bender Gestalt test (Lezak, 1983).

Training consisted of six 45-min sessions of practice with two computer programs, one for finding odd shapes within arrays of similar shapes and one for speed-reading of words. During practice with these programs, the investigator verbally cued the subject to turn to the left during scanning. The subject was then encouraged to give himself verbal cues to turn and scan left. Findings showed that word reading improved significantly (p < 0.001) after treatment whereas the Bender Gestalt test performance did not (p > 0.05). Once again, we see near transfer of learning to a task that is different from the training task in only a surface characteristic—the words contained in the lists. However, when several surface characteristics change between the training and evaluation tasks, intermediate transfer of learning does not occur. The Bender Gestalt test was different from the training tasks in presentation mode (written versus computer screen presentation), in the movement required to respond (drawing with a pencil versus pushing a single key on a computer keyboard), in the variable attribute of size, and in the number of steps required to complete the two tasks. Therefore, visual scanning learning did not transfer from the computer visual spatial task to the Bender Gestalt test.

Robertson and colleagues (1988) instructed their subject in a scanning strategy in the context of two different types of tasks, one verbal and one spatial. Theoretically, this variety of training tasks should have promoted intermediate transfer of learning, but it did not. The length of training time might not have been sufficient for this subject to learn the strategy well enough to transfer it to tasks that differed in more than one surface characteristic from the training tasks. Or there might not have been sufficient variety in the training tasks to promote intermediate transfer. Perhaps intermediate transfer would have occurred if noncomputer tasks had been used as well.

Another possible explanation for the results of this single case study is that the subject might not have had sufficient cognitive abilities to accomplish intermediate transfer of learning. Though the subject’s concentration and verbal memory were above the mean for his age, his injury was severe. The investigators reported that his Glasgow Coma Scale score on admission was 3 and his duration of posttraumatic amnesia was 2 weeks. He also suffered a cardiac arrest 2 days after the accident. A computed tomography (CT) scan of his brain showed “widespread contusions in the basal ganglia, and effacement of the third ventricle” (Robertson et al., 1988, p. 152). Therefore, this subject’s general information-processing capacities may have remained impaired. Because this study was conducted only 2 months after this subject’s injury, it is also possible that he had not yet recovered enough of his cortical information-processing capacities to accomplish intermediate transfer. Because the subcortical structures he would need for association learning and near transfer were relatively intact, he was able to show near transfer of learning between the verbal training and evaluation tasks.

These three studies, then, suggest that near transfer of perceptual retraining learning can occur for adults with diffuse brain injury secondary to head trauma, for both acute and long-term clients, with severe injuries and residual cognitive deficits (subject characteristics), using training times ranging from 5 days to 6 weeks (see Table 1). All of the studies trained and evaluated for near transfer of learning (training characteristics).

Intermediate transfer, however, was not found in the one study in this group (Robertson et al., 1988) that explicitly trained and evaluated for intermediate transfer, possibly because of the severity of the subject’s injury. What have other investigators found about intermediate transfer in this population?

Intermediate Transfer

Some studies have demonstrated intermediate transfer of perceptual learning in adults with diffuse brain injury secondary to trauma or anoxia; others have not. One outcome study, for example, showed an increase in percep-
tual test scores after a perceptual retraining regime that was part of a total rehabilitation program (Scherzer, 1986). It is difficult, in this study, to determine the specific contribution of perceptual retraining techniques to the general outcomes of the rehabilitation program in which they were used. Additionally, this study did not use a control or alternative treatment group to assess the relative effectiveness of perceptual retraining in promoting transfer of perceptual learning.

Scherzer (1986) examined the psychometric test score changes after rehabilitation for 32 adults (25 men and 7 women) with severe head injury. Their average length of coma was 46 days; age range was 19 years to 44 years, and time since injury was 12 to 249 months. All subjects were given a psychometric battery upon admission to the program and after 30 weeks of treatment. The test battery was made up of standardized tests such as the Weschler Adult Intelligence Scale-Revised (WAIS-R), Raven’s Progressive Matrices, Trails A and B, and Benton form C copy (Lezak, 1983). Pretest scores were not reported, so the postinjury cognitive status of these subjects is unknown. The treatment included cognitive and perceptual remediation, problem-solving learning, personal counseling, physical exercise and relaxation, social skills, and prevocational training. As a group, subjects showed significant improvement in basic psychomotor tests of attention, no significant change in manual dexterity and coordination, most improvement in visual processing and in the WAIS-R performance tasks, and little change in verbal ideation, despite the deficits evident in the pretests. Thus, subjects showed intermediate transfer to tests that had only three to six different surface characteristics from the training tasks, but did not show far transfer to tests that differed more than that.

In contrast, Sivak, Hill, and Olson (1984) did not find intermediate transfer. They conducted a pilot study to test the transfer of perceptual skills learned on microcomputer video tasks to paper-and-pencil perceptual evaluations. Four subjects with acquired brain damage were given a perceptual battery pretest, followed by 10 hr of computer training, followed by a perceptual battery posttest. Two of the subjects had head injury, one a 17-year-old male who was 42 months postonset, the other a 20-year-old female who was 25 months postonset. The cognitive status of both subjects was just below average as measured by neuropsychological testing. The perceptual battery consisted of nine subtests including the WAIS-R Block Design, Picture Completion, and Picture Arrangement Tests, the Rey-Osterrieth Complex Figure Test, the Trial Making Test (forms A & B), the Symbol Digit Modalities Test (Lezak, 1983), and a cancellation task scored for time and number of correct responses. The video training tasks were commercially available programs designed to train a wide range of skills such as right-left discrimination, color matching, visual scanning, judgment of line orientation, visual search, shape discrimination, visual memory, eye tracking, visuomotor coordination, and visual imagery.

Table 1
Summary of Perceptual Retraining Studies

<table>
<thead>
<tr>
<th>Authors</th>
<th>Type of Transfer of Learning</th>
<th>Subject Characteristics</th>
<th>Training Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miller (1980) (n = 8)</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Ether, Baribeau, &amp; Braun (1989) (n = 22)</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Robertson, Gray, &amp; McKenzie (1986) (n = 1)</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Scherzer (1986) (n = 32)</td>
<td>NA</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sivak, Hill, &amp; Olson (1984) (n = 2 of 4)</td>
<td>NA</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Sivak, Hill, &amp; Olson, et al. (1984) (n = 3 of 8)</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Neistadt (1992a) (n = 45)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lincoln, Whiting, Cockburn, &amp; Bhavnani (1985) (n = 6 of 33)</td>
<td>NA</td>
<td>Yes*</td>
<td>Yes*</td>
</tr>
</tbody>
</table>

Note: NA = not applicable, Acute = less than 6 months postinjury, Long term = 6 months or more postinjury, n = number of subjects with diffuse brain injury due to trauma or anoxia.

*Results may be due to spontaneous recovery, not to learning effects.
A global measure of perceptual change, a Delta Composite Perceptual Index (DCPI), was computed for each subject by averaging the amount of change on each of the nine perceptual subtests. This index could vary between -10 and +10. The average DCPI for all four subjects, including two with strokes, was 0.10. The average DCPIs for the two subjects with head injury were 0.07 for the male and 0.09 for the female. The authors concluded that there was little transfer between the training and evaluation tasks because there was "no surface similarity" (Sivak et al., p. 397) between the two sets of tasks. However, an analysis of the difference between the computer and paper-and-pencil tasks, with Toglia's (1991) definitions of surface characteristics, suggests that only three to six surface characteristics were different between the two sets of tasks—an intermediate transfer situation.

Of these two studies, one found intermediate transfer of learning after perceptual retraining and the other did not. The Scherzer (1986) study found intermediate transfer, but only from training to psychometric tests, not to functional activities. Functional performance was not measured in this study. All subjects had severe injuries that could have negatively affected their learning abilities; however, there is no way to judge the effect of these injuries on learning potential because there was no information available on subject's postinjury cognitive levels. All subjects were at least 12 months postinjury, so spontaneous recovery is not a viable explanation for the results, but the training characteristics of the treatment program might be. Subjects received their program for 30 weeks and had their perceptual retraining incorporated into all of their treatment activities, thus perceptual processing strategies were taught in the context of a variety of activities. However, we do not know whether the subjects were explicitly taught about the perceptual processes underlying their performance of different activities or whether they were given perceptual processing cues in all activities without any explanation of the rationale for those cues. Without explicit therapist identification of target perceptual skills, subjects would not necessarily see the connection between perceptual cues in different activities. Subjects who did not see this connection would not have a general concept about what perceptual skills needed to be applied in different situations and consequently would be unlikely to accomplish far and very far transfer to functional tasks with only one or no surface characteristics in common with training tasks.

The lack of intermediate transfer in the Sivak et al. (1984) study is consistent with some of the subject characteristics and all of the training characteristics of this study. Both subjects had closed head injury, and so had relatively severe (diffuse) brain injuries that may have left them reliant on association learning. Their near average postinjury cognitive status, however, suggests that they might have been capable of intermediate transfer if their training had been different. The training period in this study was very short—only 10 hr—and was restricted to computer activities only. Perhaps intermediate transfer would have occurred if the training period had been longer and if, as with the Robertson et al. study (1988), noncomputer tasks had been used as well.

The Scherzer (1986) study findings about lack of transfer between tasks that differ in more than three to six surface characteristics suggest that far transfer is particularly difficult for this population. What have other investigators found about far and very far transfer of perceptual learning in adults with diffuse brain injury secondary to trauma or anoxia?

Far and Very Far Transfer

Some studies have found far and very far transfer of perceptual learning in this population and others have not. In a study without a control group, Sivak, Hill, Henson, and colleagues (1984) found that 8 to 10 hr of perceptual training improved scores on perceptual and driving evaluations for two women and six men with acquired brain damage. The subjects ranged in age from 19 to 67 years. Their diagnoses included stroke (5) and traumatic head injury (3). The three subjects with head injury were 11 months, 33 months, and 44 months postinjury; the subjects with stroke ranged from 8 to 85 months postonset.

The pretreatment and posttreatment perceptual tests included the Picture Completion, Picture Arrangement, and Block Design subtests from the WAIS, the Symbol Digit Modalities Test, Trail Making Test, and a letter cancellation test. The driving evaluation was done on an in-traffic driving course and included measures of merging safety, traffic sign observance, driver observation skills, steering stability, and speed. Pretest information was not reported, therefore, the postinjury cognitive status of subjects is not known.

The perceptual training included work on visual scanning, spatial perception and discrimination, figure-ground differentiation, visual imagery, attention, and problem solving. Activities used in this training were cancellation tasks, pathfinding tasks, pattern visualization and identification, visual line tracing, pattern matching, and design construction and analysis.

Results showed that 47 of 59 perceptual test change scores were positive, reflecting improved performance. Driving scores improved significantly ($p < 0.01$), and driving and perceptual score changes were significantly correlated ($p < 0.05$). Fifty-three percent of the variance in driving performance was accounted for by the perceptual improvement ($r^2 = 0.53$). Thus Sivak and his colleagues' subjects showed both intermediate and very far transfer to perceptual test and driving performances, respectively.

In an experimental treatment outcome study comparing the effects of adaptive and remedial treatments for constructional deficits on meal preparation competence and constructional abilities, Neistadt (1992a) found that
subjects had difficulty with intermediate and very far transfer of learning. In this study, 45 men with diffuse brain injury secondary to head injury \((n = 42)\) or anoxia \((n = 3)\), aged 18 years to 52 years, who averaged 7.9 years since onset, were randomly assigned to one of two treatment groups. A remedial perceptual skill training group \((n = 22)\) received individual training with parquetry block assembly, and an adaptive functional skills training group \((n = 23)\) received individual training in food preparation activities. Both groups were given verbal examples of how the constructional skills they showed in treatment could be used in other activities. Both groups received individual treatment for three 30-min sessions per week for 6 weeks, in addition to their regular rehabilitation programs.

The pretest and posttest batteries included the WAIS-R Block Design test, a Parquetry Block assembly test, 2 measures of block design construction skill; and the Rabideau Kitchen Evaluation-Revised (RKE-R) \((\text{Neistadt, 1992b})\), a measure of light meal preparation skill. The mean WAIS-R Block Design score for the sample was about half of the average score for persons of like ages without brain injury.

Results of repeated measure analyses of variance showed no significant treatment effect on WAIS-R Block Design scores \((p = 0.20)\). However, the remedial group subjects performed significantly better than the adaptive group on the Parquetry Block Test after treatment \((p = 0.02)\). A Wilcoxon rank sum test analysis of the RKE-R difference scores showed that the adaptive group performed significantly better than the remedial group on the RKE-R after treatment \((p = 0.03)\). Subjects in this study, then, showed near transfer to the tests that were most similar to their treatment tasks, that is, the Parquetry Block Test for the remedial group and the RKE-R for the adaptive group. Remedial group subjects did not show intermediate transfer of learning to the WAIS-R Block Design test or far and very far transfer to the kitchen evaluation.

In another study comparing the effects of perceptual retraining and conventional occupational therapy on perceptual test and self-care activity performance, Lincoln, Whiting, Cockburn, and Bhavani \((1985)\) found that perceptual retraining did not facilitate greater intermediate and far or very far transfer of learning than more conventional treatment. These authors studied 33 subjects, aged 17 to 69 years, who were an average of 2.7 months postinjury. Six of their subjects had sustained head injuries, and 27 subjects had experienced cerebrovascular accidents. No information was reported on subjects’ postinjury cognitive status.

Pretests and posttests included the Rivermead Perceptual Assessment Battery (RPAB) and the Rivermead Activities of Daily Living scale. Subjects were randomly assigned to one of two treatment groups—perceptual training or conventional therapy. The perceptual training group received practice on perceptual tasks like stick length sorting, shape recognition games, and parquetry block construction. The conventional treatment group spent equivalent time on activities that were “not specifically designed to improve perception” \((\text{Lincoln et al., 1985, p. 100})\), like craftwork and gardening. Both groups received their respective treatments for 4 hr per week for 4 weeks.

Results showed no significant differences in improvement between the two groups on either the overall RPAB score or the activities of daily living (ADL) assessment. The perceptual training group showed significantly more improvement than the conventional group on two subtests of the RPAB—sequencing pictures and cancellation. All of these subjects, then, improved on both outcome measures, regardless of the type of treatment they had received, though no information was presented about whether the pretest to posttest changes were significant for either group. Test results suggest that the perceptual training group did show intermediate and very far transfer to the perceptual and ADL assessments, respectively, but no more so than the conventional treatment group. However, because these subjects were in the early stages of recovery, their improvements may have been due to spontaneous recovery, not learning and transfer effects.

Two of the studies reported on in this section, therefore, found very far transfer of learning in subjects after perceptual retraining and one did not. Of the two with positive results, however, one study \((\text{Lincoln et al., 1985})\) did not find any differences in the transfer of learning demonstrated by subjects who had received perceptual retraining and those who had not. Moreover, the improvements shown by subjects in the Lincoln et al. \((1985)\) study may have been due to spontaneous recovery, not learning and transfer.

In the other study that found very far transfer of learning \((\text{Sivak, Hill, Henson, et al., 1984})\), most subjects \((5 \text{ out of } 8)\) had unilateral brain damage from stroke, and one of the three subjects with traumatic head injury had a gunshot wound, which often yields a more localized pattern of lesion than closed head injury. As a group, subjects in this study may have shown very far transfer of learning because most of them had relatively localized, not diffuse brain lesions. People with more localized lesions can be expected to retain more of their learning capacities after injury than those with more diffuse injuries \((\text{Lezak, 1983})\).

Sivak, Hill, Henson, et al. \((1984)\) also deemed all of their subjects to be candidates for driving training, suggesting less than severe cognitive impairments. Persons with lesser cognitive deficits could be expected to have better learning abilities than those with severe deficits. This particular study, then, does not suggest that adults with diffuse brain injury secondary to trauma or anoxia, and severe cognitive deficits will show very far transfer of learning from remedial retraining. This study does sug-
suggest that adults with localized brain lesions and relatively good cognitive skills might be able to show very far transfer of learning after only 8 to 10 hr of training with a variety of tabletop tasks.

Neistadt's (1992a) study suggested that adults with diffuse brain injury secondary to trauma or anoxia and relatively severe cognitive deficits who are beyond early stages of recovery will not show very far transfer of learning to functional tasks after 9 hr of training with only one type of tabletop task. The relatively short training time and the lack of variety in training tasks may have been major factors limiting Neistadt's subjects from showing very far transfer of learning. It should be noted, however, that her subjects were given verbal examples of how to apply the perceptual skills they were learning with parquet blocks to functional tasks. For a population with more localized lesions and higher cognitive skills, those verbal examples may well have facilitated very far transfer to functional tasks.

Conclusions From Research Studies

Collectively, the studies reviewed above suggest that near transfer from remedial tasks to similar tasks is possible for all clients with brain injury regardless of cognitive level, severity of injury or stage of recovery, even with relatively short training periods using a restricted range of activities. However, intermediate, far, and very far transfer from remedial to functional tasks will occur only for clients with localized brain lesions and relatively good cognitive skills who have been trained with a variety of treatment tasks. Far and very far transfer from remedial to functional tasks will not occur for clients with diffuse brain injuries and severe cognitive deficits, in either early or late stages of recovery, even with a variety of training tasks and up to 6 weeks of training. This means that clients with severe injuries and cognitive deficits cannot be expected to show intermediate, far, and very far transfer from remedial to functional tasks within the limits of a rehabilitation hospital stay.

Remedial perceptual retraining, then, is not appropriate for all clients. The following section will offer some guidelines about how to determine which clients are good candidates for this intervention and how to most effectively structure remedial perceptual retraining for them.

Evaluation and Treatment Recommendations

Evaluation

Occupational therapists can evaluate clients' learning potentials in the context of ADL evaluation and training by looking at the number of repetitions clients need to learn new approaches to tasks and the type of transfer they demonstrate. For example, a client who shows no improvement in one-handed dressing after several repetitions with the same garment within one session and needs step-by-step instruction for one-handed dressing the next day is showing poor learning abilities and is likely to need a lot of repetition to remaster functional tasks. This client would not be a good candidate for remedial retraining because remedial activities would rob the client of needed repetition time with functional activities.

To assess a client's ability to transfer learning, a therapist can modify the surface characteristics of a functional task from one session to the next and see how the client responds. For a bed bath using a basin on the bedside table, soap and toiletries could be laid out in a line on the table one day and placed in a cluster the next day. The client who is confused by this change in task presentation is showing difficulty with near transfer (change in one surface characteristic) and is not a candidate for remedial retraining, which requires intermediate, far, and very far transfer of learning for functional carryover. A client who can bathe even with changes in position (sitting in a bedside chair instead of lying in bed with the head of the bed raised), arrangement of toiletries, and environment (television or radio on instead of off) is showing capacity for intermediate transfer (three to six surface characteristics changed), but is still not a good candidate for remedial retraining because most functional tasks differ from remedial tasks in more than three to six surface characteristics. A client who can bathe successfully in the shower, with soap and toiletries jumbled together in a plastic basket, is showing far transfer from the bed bath situation and may be a candidate for remedial retraining.

Even clients who demonstrate far transfer of learning in ADL tasks, however, are not candidates for remedial retraining if they cannot explain how perceptual skills learned in remedial tasks can be applied to functional tasks. For example, the client who can say, "I have trouble telling the difference between different sized jars, cans, and boxes of food in the grocery store. Working on these size pegs (graduated cylinders) is helping me tell the difference in sizes of things and that will help me in the grocery store" is a good candidate for remedial retraining. The client who says, "Puzzles have nothing to do with making a sandwich," even after you have explained that both involve constructional skills, is not a candidate for remedial retraining.

Treatment

For clients who are candidates for remedial retraining, treatment tasks must be varied and transfer of perceptual learning from remedial to functional tasks must be explicitly taught. For example, the client working on size discrimination with graduated cylinders should go to a grocery store with his or her therapist to practice perceptual strategies, such as feature analysis, that have been learned.
with the cylinders. Readers should refer to Toglia's (1991) article describing her multicontext approach for further suggestions about treatment.

Conclusion

The research and learning literature reviewed suggest that perceptual retraining regimes that are grounded in learning theory and that specifically teach transfer of learning may promote far and very far transfer of perceptual learning to functional activities for clients whose thinking is abstract enough to understand the perceptual processing similarities between very different activities. For more concrete thinkers, however, who have difficulty transferring learning across different situations, the utility of perceptual retraining methods must be questioned. Treatment time spent on perceptual retraining activities like puzzle construction is time lost from repetition of functional activities like meal preparation, and some clients may need as much repetition as possible to relearn functional skills after diffuse brain injury. ▲

References


