WORKSHOP ON LOW VISION MOBILITY

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THE WORKSHOP'S OBJECTIVES IN PERSPECTIVE

Easily 80 percent of the legally blind persons trained by orientation and mobility specialists have remaining vision which may be useful to them in some aspects of their mobility. Orientation and mobility specialists as a group are highly skilled in training blind persons to travel independently through the use of the remaining senses — with the possible exception of the use of residual vision. The emergence of a clearly teachable body of knowledge in this area has been a long time in development and is not yet available. It is expected that the Workshop will organize and solidify current knowledge. As a basis for further development, we clearly need standardized methods for evaluating low distant vision both in the clinic and in travel situations. Beyond this, there needs to be a teachable body of knowledge that orientation and

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a Held at Western Michigan University, Kalamazoo, Michigan, November 3-5, 1975, with the authors as co-directors.

b The Workshop had been planned for sponsorship by the National Research Council, Committee on Prosthetics Research and Development. Sponsorship was assumed by the Veterans Administration and the Workshop was conducted through a contract between Western Michigan University and the VA.

c Published August 1976 by the Veterans Administration, Department of Medicine and Surgery, Washington, D.C. 20420. This was the Workshop's final report, produced in a limited edition primarily for the participants.

It is that final report which is presented here, complete, lightly edited where required by this publication’s style and format.
mobility specialists can employ in aiding low vision persons to build their skill in the use of their residual vision.

This conference was important to the development of this type of orientation and mobility service to low vision persons. The emphasis is on the word “development”. A similar conference was held in 1970 under the auspices of the Office of Education. That conference stimulated the growth of interest in, and acknowledgment of the need for, work by orientation and mobility specialists with the vision of their clients. It offered material for addition to the curriculum of universities training orientation and mobility specialists. In large measure it stimulated the growth of the practice, by orientation and mobility specialists, of using functional vision evaluation for planning their teaching. The conference created a climate for work by researchers in this area.

During the 5 years since the first low vision mobility workshop, a literature has begun to grow up. One vehicle for the development of a literature has been the Low Vision Abstracts, which is published twice yearly and contains a combination of feature articles, current references, and the abstracts of studies done at the universities preparing orientation and mobility specialists. In addition, some additional bibliographies have emerged. The literature in the field of blindness contains a higher frequency of reference to low vision.

This workshop's objectives were, first, to collect and synthesize information on the present state of the art. The state of the art was in particular reference to the work now going on in orientation and mobility, work in the area of vision science, and the work of ophthalmologists and optometrists in distance vision. The intent was that we could evaluate the material collected from study of the state of the art in order to meet the second objective, that is, to put together some integrated plan of action for the future. The third objective was to report this material and disseminate it to persons who would find it useful. We expect that it will be of particular value in university curricula for orientation and mobility specialists.

All subject groups had been asked to make recommendations for the future. The Workshop focused towards a planning for needs and a statement of needs for research and activity in the areas of orientation and mobility as well as vision science, ophthalmology, and optometry. Each group was asked for a minimum of three recommendations.

The format chosen for the Workshop was based on the “Delphi Technique” which was used with particular success by the Rehabilitation Services Administration in a workshop called “Rehabilitation Planning for the Decade of the ’70’s.” This technique can be very powerful because it seeks to arrive at a workshop consensus on the subject matter. The technique was modified in that we asked for a consensus first on the material which was irrelevant to the subject of the Workshop and the
specific groups. If the remaining information represented two different points of view, it was not necessary to arrive at a consensus or synthesize them. They were clearly identified.

One of the parts of the technique which was not modified was the necessity for workshop participants to submit a paper prior to the workshop. We were not successful in having all papers in for circulation prior to the workshop, but they were available for the opening session.

Every author is identified with his group but no author is identified with his own paper, as that paper lost its identity during the course of the workshop. There was a provision that if a member of the group wanted to keep his paper identifiable, that would be a group decision, but none of the workshop participants requested this privilege.

The chairman of the Workshop retained the right of editorship of material on presentation. This was done in order to insure that there would not be duplicative sections, and for the continuity of presentation.

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d Workshop participants are listed by groups in Appendix C of this report.
INTRODUCTION

Historically, in education as in rehabilitation, individuals who were identified as legally blind were given basically the same training and educational programs as designed for totally blind individuals. This included people having low vision, residual vision, travel vision, and other such classifications. One reason for this procedure was to conserve the remaining vision of these individuals by minimal use or non-use of their remaining vision.

Another reason may have been that teachers (blind or sighted) failed to assess the perceptual act as to the kind and amount of information the low vision person received. In most instances, the only information concerning the individual’s visual functioning available to the teacher or rehabilitation worker was a reported acuity, such as “5/200.”

Since 1964, greater emphasis has been placed on research and training for individuals with low vision. This increasing emphasis stems primarily from two factors. The first is that approximately 80-90 percent of all people classified as legally blind have some remaining vision. Obviously, this is the largest portion of the visually impaired population. It is also the least understood portion in terms of assessment and training of visual efficiency. This lack of understanding is shared by rehabilitation personnel, educators, ophthalmologists, and optometrists. The second factor which drew attention to the low vision individual was a study completed by Dr. N. Barraga (1964). This study demonstrated that with a limited training period, low vision children could learn to use their near vision more efficiently (i.e., going from braille to reading print using the remaining vision).

Success in the area of training distance visual efficiency will require the bringing together of all the professional and voluntary resources available. This will involve educational and rehabilitative services for all blind and visually impaired persons including both children and older individuals. The achievement of such an ambitious goal requires very careful planning. Much of our effort in the past has been piecemeal and uncoordinated. As a result of the current economic situation, uncoordinated efforts are totally inappropriate. Effective planning has become vital to industry, cities, states, and the Federal Government, and it must become a central theme in the field of work for the blind as well.

On this basis, the co-directors of this conference met in Washington, D.C., with a representative from the Committee on Prosthetics Research and Development (CPRD), National Academy of Sciences — National Research Council, to select a small group of distinguished professionals representing a variety of disciplines (see Appendix A). The co-directors prepared an agenda for this planning meeting which included a tentative list of content areas and a recommended workshop format.
The Planning Committee (see Appendix B) met on December 8-9, 1974, in Minneapolis, Minnesota. In summary, the Planning Committee recommended that a workshop on low vision mobility be held November 3-5, 1975 at Western Michigan University, Kalamazoo, Michigan. The workshop should comprise 30-35 invited participants selected by the planning group for their recognized knowledge and expertise. Participants should represent disciplines in basic research and professions relating to work for the blind and visually impaired including: perceptual psychology, developmental psychology, behavior modification, special education, optometry, ophthalmology, orientation and mobility, social psychology, psychiatry, blind rehabilitation, and social work. A list of suggested participants as well as a list of alternates was prepared by the Planning Committee. The Planning Committee carefully divided the workshop into five subtopics and assigned approximately six participants to each group (see Appendix C). An adequate mix of disciplines was maintained in each group.

The organization of the conference was as follows:

1. One (or two) member(s) of each subtopic group was selected to prepare a position paper of not more than 20 pages.
2. This paper (or papers) was distributed to other members of that specific subtopic group.
3. The members of the subtopic group were required to prepare a response to the position paper (papers) of not more than 10 pages.
4. These response papers were then distributed to all members of the subtopic group prior to the workshop. The objective was to have all participants arrive at the workshop having given some thought to the development of a consensus through the integration of all the responses.
5. At the workshop the papers would be reviewed by the subtopic groups and thus by the entire workshop; modified, retyped, and again reviewed by the separate subtopic group and the entire workshop. After the workshop the reports would be turned over to the editors for final editing and publishing.

The sections that follow make up the final report of the Workshop on Low Vision Mobility.

Bruce B. Blasch, Ph. D.

EVALUATION OF VISUAL FUNCTION

Evaluation of the effects of deprivation or impoverishment of vision should, logically, be preceded by an analysis of the function of the normal visual system in the absence of anatomical or functional degradation. The traditional approach of visual science has emphasized anatomy and physiology, with marginal attention to the role of the visual system in everyday life. In the present context, it is helpful to pay
attention to function, and to analyze the processing of information by the visual system as it relates to the dynamic adjustment of the individual.

**Role of Peripheral Stimulation**

Considerable attention has been directed in the visual literature to the fovea because of the marked superiority of form, resolution, motion, and color sensitivity in the central portion of the retina. However, the fovea represents only a small fraction of the entire visual field, with the periphery accounting for more than 98 percent of the total light-sensitive surface.

The function, as well as the anatomy and the physiology, of the periphery is different from that of the fovea and plays a complementary role to it. The peripheral regions subserve a monitoring function, signaling when an eye movement, resulting in foveal fixation, is appropriate. Peripheral stimulation maintains a level of marginal awareness, leading to central fixation and full attention only when an event of special interest or significance is ascertained. Thus the periphery and fovea complement each other, the former producing a vague diffuse awareness over a large portion of the visual field, and providing a monitoring and selection mechanism for subsequent fixation and concentrated attention. It is widely recognized among clinicians that the integrity of the peripheral visual fields is essential to the optimum functioning of the visual system. In the normal course of visual information processing, the periphery provides information as to where the eye should fixate next. An object of interest is frequently first ascertained from peripheral inputs for subsequent detailed examination with the fovea. Peripheral vision has been implicated as a major factor in any situation in which a large area must be monitored such as driving a car, flying, visual inspection in industry, etc. The deficits of peripheral vision are, as would be expected, sensitive indices of ocular and neurological pathology, and perimetric examinations play a major diagnostic role in ophthalmology, neurology, and optometry.

The inferior discrimination of the periphery, well documented, fits nicely with the functional significance of this region and correlates with the known properties of the receptors and with retinal and post-retinal neural organization. It is reasonable to assume that critical stimulus characteristics may be different for foveal vision as compared to the periphery. It is heuristic to analyze some of the differences between the fovea and the periphery in the present context in order to determine the effects of degradation on the impairment of visual function.

**Two Modes of Processing Visual Information**

In the late 60's, a group of neuroscientists in the Boston area sug-
gested a model of visual function based upon two modes of processing information ("two visual systems"). (Ingle, 1967; Schneider, 1967, 1969; Trevarthen, 1968; Held, 1968, 1970; Humphrey, 1974.) They distinguished between a system which analyses form and contour which is predominantly foveal and mediated by cortical mechanisms, and a localization system which is predominantly peripheral and mediated by subcortical mechanisms. In effect, these reflect separate modes for answering the "what" as compared with the "where" question of visual stimulation. This dichotomy is relative rather than absolute, and provides a heuristic conceptual model for classifying visual function.

An excellent example of the two-visual-systems concept was reported in separate studies on residual vision among brain-damaged humans (Pöppel, et al., 1973; Sanders, et al., 1974). These patients with cortical brain damage, when tested with conventional perimetry, demonstrated marked scotomas. However, when the subjects were asked to localize stimuli within the scotomatous region by means of eye movements, they were able to do so quite accurately. This apparently paradoxical result can perhaps be best understood within the context of the "two visual systems" concept. The "where" system, which is closely coupled with motor mechanisms, remained intact; the "what" system, as reflected by a verbal report process, was relatively nonfunctional.

These data, which were preceded by extensive and elegant studies in experimental animals, suggest that accurate assessment of visual function is not unitary but rather depends on which mode of visual processing is being evaluated. Since mobility depends on a functioning localization system, it may be inappropriate to evaluate this system by verbal report. Rather, a measure based on eye movements, pointing, or some other non-verbal response would be more relevant and valuable. Indeed, Held and his colleagues have dramatically demonstrated behavioral differences in several perceptual functions depending upon the measuring techniques, i.e., verbal response vs. motor localization (Held, 1968).

During World War I, the neurologist Riddoch (1917) suggested that cerebral damage selectively impairs the ability to discriminate stationary objects in the periphery, without influencing the appreciation of peripherally presented moving stimuli. Putting aside for the moment the neurological issues as to whether the "Riddoch Effect" is specific to occipital lesions (Zappia, et al., 1971), it is heuristic to note the rational thread which appears to be running through a number of studies. The effect of correction of peripheral dioptrics, psychophysical studies of normal and brain-damaged adults, and ablation studies with experimental animals all seem to fit nicely into the two modes of processing, or the "two visual systems" concept. If the functional difference between identification or "what" on one hand, as compared with localization or
“where” on the other hand, is viable, it would provide a convenient way of looking at visual function and its deficiencies and provide a rational basis for improvement.

It is interesting to note that the significance of many relevant clinical findings has not been fully appreciated within the context of basic laboratory investigations of the “two visual systems.” Similarly, the clinical reports have not been integrated with the “two visual systems” literature. If indeed we have two functionally different systems, the logical questions to be posed are:

1. Which mode of processing is critical to the particular task faced by the individual?
2. Is there selective impairment of one of these systems? and,
3. What kind of aids and training procedures can be recommended to overcome these deficiencies?

**Luminance**

The most important stimulus variable for the normal visual system is the luminance of the stimulus. With increasing luminance, visual resolution, intensity discrimination, and depth perception are improved. Color discrimination is possible only at the higher luminance levels. For these justifiable reasons, specification of illumination is critical for schools, factories, highways, etc., and plays a major role in modern illumination engineering practice. However, if one considers the role of the visual system in one’s everyday adjustment to the environment, the universality of this principle is called into question. For example, in the fovea, visual resolution is highly sensitive to luminance over a wide range, and even a small reduction in luminance can change acuity significantly. However, as one moves into the periphery, the resolution-luminance function becomes flatter and the ability to discriminate detail becomes essentially independent of luminance (Kerr, 1971).

A similar situation occurs with absolute threshold. A small reduction in stimulus energy will markedly lower the frequency of seeing function. However, if for these same stimuli, the subject is asked to localize the stimulus in space, the rather astonishing result is that luminance has no effect as long as the stimulus is visible (Leibowitz, et al., 1955 a,b). If the stimulus is seen, localization accuracy is literally independent of luminance level.

This functional difference is important both practically and theoretically. While our concern for maintaining adequate luminance levels for foveal vision is justified, maintenance of the same levels for peripheral tasks is not only wasteful, but may lead to undesirable effects such as glare which can interfere with visual function. This is particularly undesirable for observers with incipient cataracts or other opacities in their optical media. Theoretically, these data imply that we are dealing with
two different systems which exhibit different relationships with respect to fundamental variables.

**Contrast Sensitivity**

It has been well established that the sensitivity to contrast is a particularly important aspect of normal visual function. The significance of the contrast-sensitivity function may be especially pertinent to the visually impaired individual. Bodis-Wollner (1972) has found that deficits associated with lesions of the visual cortex often do not manifest themselves under standard (high-contrast) visual acuity testing procedures. However, visual acuity for low-contrast targets differs markedly between normal and central neurological defect populations. This implies that the evaluation of visual function of the visually impaired over a range of contrast conditions may provide potentially useful additional information.

**Refractive Error**

It is axiomatic that the optical quality of the retinal image is critical for foveal vision. Of all the health services available in this country, clinical refraction is possibly one of the most universally administered. Because of the premium in terms of efficiency and adjustment associated with the ability to see clearly, spectacles are fitted with great precision and closely related for developmental changes. It is significant to note, however, that the refraction procedure is limited exclusively to foveal vision: no attention whatsoever is paid to the peripheral region in spite of its importance in visual adjustment. Is this concentration on foveal refraction, and the disregard of the periphery, justified? Recent experiments on this topic provide both a negative and a positive answer to this question.

It has been known for some time that peripheral refractive characteristics may differ from those in the fovea. Individuals with identical (normal) foveal correction can exhibit striking differences in peripheral refraction (Ferree, et al., 1931; Lotmar and Lotmar, 1974). Some subjects become more myopic in the periphery while others become more hyperopic. Furthermore, these differences may depend upon the meridian; one individual may be hyperopic in both the vertical and horizontal meridians, others may be myopic in one and hyperopic in the other, etc. Thus, observers with identical foveal vision may exhibit large overall differences when one considers their peripheral refraction over the entire visual field.

In a recent series of experiments, the attempt has been made to determine whether such dioptic differences are functionally significant. In these studies, peripheral refractive error was determined individually for each axis of observation, and corrected experimentally for
the particular angle of eccentricity of the stimulus. With respect to perception of motion, the data indicate a marked improvement in motion threshold with correction of peripheral refractive error (Leibowitz, et al., 1972). Although the subjects initially demonstrated considerable individual differences in the ability to detect moving stimuli in the periphery without correction of peripheral error, with correction all improved. At the same time, intersubject variability was considerably reduced. These data point to the fact that the quality of the retinal image, rather than neural factors, limits detection of motion in the periphery.

Utilizing the same refractive techniques, and some of the same experimental subjects, the effect of refractive error on peripheral resolution was also determined (Millodot, et al., 1973). The results are strikingly different from those for detection of motion. In separate experiments, carried out in two different laboratories, no improvement of peripheral resolution was observed as a result of correction of refractive error. It is not clear how such data should be interpreted theoretically. However, these results suggest than an understanding of normal visual function and its degradation must include foveal as well as peripheral vision with special attention to particular aspects of visual discrimination. For example, the loss of peripheral vision would pose less of a vocational handicap for workers whose habitual seeing tasks involve foveal vision, e.g., industrial inspector, seamstress, medical technician, than for those for whom the monitoring function of the periphery is essential, such as driving a car or air traffic control. Similarly the effect of impairment of the dioptrics of the eye resulting in a lower quality of the retinal image should be analyzed in terms of the functional significance of the foveal and peripheral regions and their differential functional degradation as a result of retinal image blur.

It is important to recognize that different visual tasks are critically related to particular aspects of vision, so that the result of impairment of the visual system would be expected to be specific rather than general.

Intermediate Dark-Focus

Recent research with the laser optometer indicates that the equilibrium or relaxed position of accommodation, the dark-focus, corresponds to an intermediate distance (mean of 58 cm or 1.7 diophr among college students wearing their refraction, if any) rather than to optical infinity as has been traditionally assumed. The intersubject variability is quite high, the dark-focus ranging from 25 cm to optical infinity among this college group. The intermediate dark-focus is significant in relation to the anomalous myopias, e.g., night, empty-field, and instrument myopia (Leibowitz and Owens, 1975). Whenever the stimulus to accommodation is degraded by lowered illumination or contrast, accom-
accommodation will tend to return to an individually determined dark-focus. Since lowered illumination and contrast are typical of many low vision patients, it would be expected that their accommodation would tend to correspond to an intermediate dark or equilibrium focus. Recent research suggests that a similar situation is characteristic of convergence in the dark as well.

The question of precise adjustment of the oculomotor system is relevant only for those low vision patients with a normally functioning oculomotor system. However, for this relatively small population, passive return to an intermediate dark-focus may offer an explanation for anomalous accommodation or convergence.

**Relationship to Vestibular-Optical Reflexes**

The visual system is, of course, part of a total functioning organism. If we consider the dynamic adjustment of the individual in the environment, it becomes clear that visual information is continually being processed and evaluated in comparison with stimulation from the vestibular and postural systems. While this process is in operation continually, we are usually not aware of it except under special circumstances such as when a discrepancy arises between the vestibular and visual inputs. This may occur when the body is suddenly accelerated as on a ship or aircraft. The phenomenon of optical nystagmus is another well known example of vestibular-visual interaction. Recently, researchers at the University of Freiburg in West Germany have extensively studied the behavioral and neurological aspects of vestibular-visual interaction (Dichgans and Brandt, 1974; Brandt, et al., 1973). For the present purposes, it is important to note that our sense of body position and of body motion depends upon the joint function of the vestibular and visual systems. Furthermore, the peripheral visual fields have a major input to our appreciation of body motion. Although we are more aware of stimuli which stimulate the central portion of the retina, the peripheral regions play a more important role in sensing body position. It is “as if” two gradients exist; with increasing eccentricity, awareness decreases, while at the same time peripheral stimulation has a greater influence on unconscious reflex behavior.

It is not certain whether these findings are best interpreted in terms of the two-visual-systems concept. However, they are significant when one considers the functional role of peripheral stimulation in the context of the present symposium. It is always tempting to interpret visual function in terms of our own experience, and certainly much valuable information has been obtained by this method. On the other hand, we must not overlook the role of vision in maintaining body posture and body awareness for which the role of unconscious visually mediated reflexes is so significant.
Perceptual Learning and Visual Training

The ability of the human organism to improve its effectiveness with respect to visual stimulation has been well documented. Depending upon the academic base of the writer, this may be referred to as perceptual learning, blur interpretation, visual training, or visual rehabilitation. Whatever the title, profound changes take place in response to visual stimuli either as a function of time in the natural environment, or as a result of specific training procedures.

One of the most interesting aspects of this literature is that most of the improvement appears to take place with respect to peripherally presented stimuli.

For example, the classical studies by Low on peripheral visual acuity show a marked improvement in peripheral resolution with practice. Chris Johnson and H. Leibowitz (1974) have recently confirmed the familiar observation that the ability to detect moving stimuli in the periphery improves with practice. In fact, this improvement is a major obstacle to overcome in peripheral studies if the experimenter is to be certain that changes in the dependent variable are due to factors other than experience. If the situation is made more “life like” by requiring the subject to attend to something other than the discriminative stimulus, dramatic changes with practice have been noted. Charles Abernathy and H. Leibowitz (1971) reported that absolute threshold in the periphery can be as much as a thousand times higher at the beginning of an experiment involving a dual-task perceptual motor load, than is the final threshold with practiced subjects. It should also be noted that providing immediate feedback with practice will produce still further improvements in peripheral visual performance.

A few years ago, Albert Burg (1968), in his mammoth study of visual factors in automotive safety, determined visual fields for more than 10,000 California drivers. It is not surprising that the curves describing visual field size as a function of age documents a decline among older observers. This is to be expected in terms of the clouding of the ocular media and other age-related physiological factors. What is most surprising, however, is that some of the curves show an increase from age 16 (the youngest tested) to the mid-30’s, a period in which the aging process has already set in but for which field sizes are nevertheless apparently increasing. This is most probably attributable to learning effects which override the opposite influences of aging.

The clinical visual training literature is also revealing in that many of the tasks which are trained and trainable involve peripheral vision—e.g., visual field expansion and tachistoscopic skills.

The functional role of peripheral vision is well recognized among sports medicine specialists and athletic coaches. The contribution of the periphery to skilled performance is well accepted within the sports
medicine – athletic community. Coaches in sports such as basketball, soccer, and football maintain, justifiably, that an attribute of a skilled athlete is superior ability in the use of peripheral vision.

If one looks for examples of learning with respect to peripheral stimulation, they are extremely easy to find. One of the basic perceptual functions which has been of continuing interest to psychologists for almost a century is that of size constancy (Leibowitz, 1974). This process permits us to judge the correct sizes of objects in spite of the variations in the retinal image sizes as a function of changing distances. This literature consists of several hundred papers from which two fundamental facts of relevance in the present situation should be noted. For distant objects, beyond the range of the oculomotor adjustments, it is essential for size constancy among adults that the peripheral visual fields be simultaneously visible. If one blocks off peripheral stimulation, size constancy for distant objects is lost. The functions for adults temporarily deprived of peripheral vision are strikingly similar to functions obtained for children. It is “as if” the children had not learned to use the cues derivable from peripheral stimulation. The exact mechanisms are not known, but it would appear that with many years of experience, children learn somehow to utilize peripheral input as a mechanism for subserving size constancy. This is not an intellectual process; no differentiation between feebleminded and normal observers had been observed. The role of peripheral learning in size constancy is extremely slow. For normal terrestrial observation conditions, the process is not complete until adolescence.

It is not suggested that perceptual learning does not take place with respect to foveal stimulation. However, a striking portion of the literature on perceptual learning implicates the peripheral regions as being more plastic and more susceptible to modification through training and experience.

Some General Comments

It would be inaccurate and misleading to suggest that the scientific method represents the optimum approach to any class of societal problems. The skills of the experienced and well-motivated clinician are indispensable in many situations in which we all find ourselves from time to time. On the other hand, when the scientific method is applicable, it presents many advantages and must be considered a reasonable first approximation in many situations including the one we face in this symposium. In order to maximize the usefulness of this particular approach, it is extremely valuable to pay attention to the type of question we should be asking. While there is certainly no assurance, explicit or implicit, of success, it is hoped that our thinking will be clarified by considering the visual system and its impairment in terms of the func-
tional differentiation between the periphery and the fovea and the concept of the two visual systems. e

*Recommendations* in the form of guidelines for the future were made by the group (Group 1) whose report appears above. Their recommendations will be found under the heading "Recommendations from Group 1, Concerning the Evaluation of Visual Function" on page 118.
VISUAL TRAINING WITHOUT AIDS

Introduction

Only a small percent of visually impaired persons are totally blind. With a large percent of visually impaired persons having some residual sight, the question becomes how to maximize their mobility. An important first step (but one not relevant to our topic) is to maximize the use of this capacity with the best possible optical aids. However, for various reasons optical aids are not always used. In some cases, the expertise is not available for diagnosis and prescription. In other cases there are attitudinal problems which militate against use. Even when optical aids are used, but especially when they aren’t, there are general questions about perceptual training which need to be addressed.

Visual vs. Perceptual Problems

Perceptual training without aids allows the focus to be placed on information the environment affords, or on the person detecting and processing the information. In terms of the person detecting and processing the information it is easy to document the visual impairment.

1. Contrictions of the peripheral field.
   a. Approximately concentric, such as in retinitis pigmentosa or advanced glaucoma.
   b. Hemianoptic or sector defects caused by such conditions as brain tumors or blood clots, (e.g., tumor of the chiasm causing bitemporal hemianopsia or quadrantanopsia, bilateral retinal detachments).

2. Disseminated or dense opacification which does not permit magnification to improve acuity (e.g., multiple vitreous hemorrhages or vitreous floaters, severely eccentric pupil, dense corneal scarring or dense cataract which cannot be removed for health reasons such as diabetes or hypertension).

3. Extreme photophobia which is aggravated or caused by magnification which improves acuity (e.g., rod achromatopsia or albinism).

4. Large central scotomas (limited blind areas greater than 10 deg) e.g., macular hemorrhage.

In most cases, however, these impairments are not directly tied to perceptual difficulties. One can guess what problems the low vision person might have. But, depending on the severity of the visual impairment, the ingenuity, ecology, and life-style of the individual in question, one could be quite wrong. Distance judgments and color perception, for example, might not be especially affected by resolution problems. But social judgments based on facial expressions might be. The entire face at
a "social-consultative" distance of about 10 ft subtends only about 6 deg, and critical small details of the face may subtend less than 1 deg. And while vocal social information can be used for judging certain emotional states of a speaker as well as facial information, the adult with normal vision usually lends more weight to the facial cues.

It has been suggested that professionals working in low vision rehabilitation areas have only recently begun to address the "particular needs of the low vision individual." But what are these needs? It has also been suggested that orientation and mobility specialists "lack training in relevant situations." But what are the relevant situations? How can we develop a meaningful and representative concept of specific perceptual behavior problems, which would then become the basis for training and its evaluation?

One approach to discovering the critical perceptual problems of a low vision individual could be based on Egon Brunswik's Functionalist methods (12). For example, a professional staff member or field researcher could literally travel with the low vision person, observing his perceptually based behaviors, asking questions when necessary, and carefully recording successful and unsuccessful perceptual behaviors and decisions based on percepts. Perhaps the stress should be on the unsuccessful behaviors, using a critical incidents framework. For example, were there problems in such and such an environment in determining whether:

1. One object is nearer the observer than another—at x distance?
2. That person is speaking to the observer?
3. The person speaking is Joe, Jim, or Mary?
4. The recognition of Jim was based on face, clothes, or context?
5. The door is to a men's room or a ladies' room?
6. The gender of the door is indicated by printed word (and what size letters), or abstruse diagram?
7. That is a curb or a shadow?
8. That truck is moving?
9. That truck is moving toward or away from the observer?

In this way, a veritable catalog and perceptual skills profile of that individual's perceptual difficulties (and abilities) would become available:

1. To the therapist-practitioner, for designing client-geared programs for solving particular problems, in order of their importance.
2. For research. If such records could be subjected to cluster analyses (or some similar technique for discovering natural groupings of perceptual problems) key clusters could then be subjected to research aimed at solving more general perceptual problems occurring across individuals, situations, and diagnostic classifications.
3. For evaluation. The records of individuals could be systematically compared over time, and before and after particular training procedures, to help assess the progress of the individual, and the value of particular training methods.

If the above Brunswickian program of cataloging perceptual encounters sounds nice, but is impractical due to limited resources or personnel, is there an alternative? A simplified version might use a self-report critical incidents technique. The low vision individual would be trained to keep such a log of perceptual failures and successes, carefully noting the situations surrounding collisions, falls, mis-read signs, social miscues, etc. Perhaps not every low vision person would or could perform such a task, but on the other hand, many probably could.

This sort of functional analysis is a promising approach both for identification of generally critical perceptual situations and for identifying individual differences among people. Thus one could identify perceptually important situations for different age groups as well as for groups with different degrees of visual impairment.

An alternative approach, still focusing on the environment, is a formal analysis of information afforded by the environment. To the best of our knowledge such an analysis for a person with low vision has not been done. Undoubtedly much of the sort of knowledge we have in mind is already in the lore of the mobility trainer and in the actual practice of the successfully mobile person with low vision. Emerson Foulke (1971), for example, describes a blind pedestrian’s potential use of the redundancy in man-made environments (e.g., the sidewalk being raised relative to the street and separated from it in many American cities by a strip of unpaved surface; the high point of a street being at its center with the roadway sloping down on each side to a gutter). Similarly one can make use of the different sorts of resonance occurring when one walks under an arch from a completely open space. Are there also other environmental contingencies and regularities which would tell whether surfaces extend uniformly relatively far or whether they are likely to be broken and irregular? Are there airflow patterns that specify open paths, leaves on the ground that specify the presence of trees—can we tell what kinds of trees?

So far these comments have concerned static environments, but for safety a person also has to be concerned with moving objects. David Lee (1974) has worked out the mathematics of a suggestion by J. J. Gibson to the effect that the changing pattern of stimulation projected by an approaching object specifies its time of impact. (William Schiff, among others, has shown that many humans and animals are sensitive to this information.) Recently Pittenger (1972) performed a similar analysis of the information in an approaching auditory stimulus; the pattern of
intensity change specifies the time-to-impact. The change in symmetry of the sound pattern also specifies whether an object will hit or miss. It is believed that people’s sensitivity to this sort of environmental information has not been determined. This leads to the second focus.

Detection and Processing of Information

How do people detect and process information? The question of detection of information immediately implicates the concept of threshold. The amenability of perceptual threshold to change is an important concern in mobility training.

There is a large classical literature in perception on the issue of improvement in psychological thresholds as a function of practice. Unfortunately, in this body of literature the problem of change in sensitivity was not ordinarily separated from the problem of change in criterion of response as is done in modern signal-detection approaches. Many of the apparent improvements in threshold are easily attributable to changes in criteria for making positive judgments. In addition, some of the more interesting examples of threshold change occur with judgments of more complex stimuli varying along several dimensions. With such stimuli it seems reasonable to suggest that changes in threshold involve shifting the basis of judgments from one dimension to another. This kind of phenomenon has received considerably more attention recently under the rubric of perceptual learning and selective attention. The idea is that people are able, selectively, to attend to some stimulus dimensions and apparently inhibit processing of other dimensions. Depending on the nature of the dimensions, such selectivity can be switched. It is also possible to train people to attend to such dimensions of difference and ignore others; they often learn this more readily than they learn to identify specific objects.

Training of visually impaired persons to perform mobility tasks can capitalize on the ability of people to learn to attend to stimulus dimensions but care must be given to selection of the correct dimensions. The kinds of surveys and analyses suggested above may be helpful but it should be kept in mind that the dimensions which are important in the task might change as the learner becomes more proficient. It is not an unusual result in perceptual-motor tasks that different sorts of information are utilized early and late in learning. Reading is an obvious example, where letter discrimination is crucial early in learning to read but much higher-order information is crucial later on.

Another distinction in stimulus information is often emphasized in mobility training—the difference between near and far vision. One must be cautious about making this distinction too sharply. Various kinds of perceptual discrimination would seem to be important for both. Shape (form discrimination) is often considered relevant to near visual tasks.
However identification of objects at a distance, often done on the basis of shape, can be very important for safe mobility.

Another area of perceptual training for mobility includes strategies to maximize information pickup. At the most primitive level it may be necessary for a person with low vision to learn that vision is a directed sense modality. If one is used to processing auditory information it may not be obvious that the sense organ must be directed to obtain optimal input.

More generally, various techniques of scanning might need to be taught for optimizing intake. The particular type of visual problem might dictate the best scanning strategy. Consider the following examples:

1. If a severe limitation of visual field exists, use of eye, head, and body movements to compensate for the reduction in functioning visual field should be stressed. These movements also aid in estimation of depth by "motion parallax" which is especially important if the subject is essentially monocular. Here the student is taught to observe that objects which are nearer than the object being fixated tend to show an "against" movement with respect to that viewed object. The nearer the object to the observer (i.e., the greater the displacement of the test object from the fixated reference object), the faster the "against" movement. Objects located further than the fixated reference object are observed to move in the same direction as the movement of the head, a so-called "with" movement while the fixated reference remains stationary. Again the greater the displacement of the test object behind the reference object the faster the "with" movement.

2. In the case of gross central scotomas, imaging an object on this retinal area will produce very poor resolution. If peripheral retina is normal or at least partially functional, teach the student eccentric fixation (i.e., turn the eyes the least amount to the side so that the image of the spatial object of interest falls on the functioning visual receptors). Thus, the student must be taught a mismatch between oculocentric direction and egocentric localization in the interest of better information gathering. This is usually found to be extremely difficult for persons in whom a low vision condition is developing after many years of normal visual function. However, when this skill is mastered remarkable improvements in visual resolution occur.

3. Large rhythmic pendular ocular nystagmoid movements are generally observed in albinism and other congenital conditions in which developmental macular impairments occur. Achieving a reduction in the frequency and amplitude of these nystagmoid movements often results in marked improvement in acuity. The low vision person has often learned to turn his head to the side to place his better eye at the end of the range of lateral gaze to mechanically damp the frequency and
amplitude of nystagmoid oscillations. If he has not learned this "trick" himself, teaching him to do this will often vastly improve the stability of central fixation and with it, central visual acuity. In other cases ocular nystagmus is caused by vestibular involvement with no direct ocular etiology at all. The reduction in visual acuity, however, is just as severe.

A considerable body of research suggests the importance of self-produced (reafferent) stimulation for adequate perceptual development. Besides its value in motion parallax, self-produced stimulation may be more generally important for training in the use of residual vision and for development of the use of nonvisual information. For example, under severely degraded vision, might not the most vivid demonstration of optical expansion occur when a person generates such patterns for himself by moving an object toward his face? Of course this example is for near vision and the trainer must be concerned with whether it will generalize to far vision. That is an empirical question. In the case of nonvisual perceptual development, researchers like Fraiberg have noted the developmental lag in the tendency of blind infants to persist in reaching for objects. Such a delay may be a symptom of retarded development of the object concept in infants. Work of T. G. R. Bower has suggested that if, for example, auditory feedback is made contingent upon continued exploration of the object, the lag might be eliminated.

With visually handicapped persons the useful integration of information from several sense modalities may be a problem. On the one hand some visually handicapped persons may not utilize their residual vision at anywhere near its maximal level. This can be an attitudinal problem encouraged by a certain amount of reinforcement for functioning as a totally blind person, or it can be because they have never been trained to use their residual vision or have even been discouraged from using it. In such cases significant shifts in willingness to use vision might occur if reinforcement contingencies are reversed and the use of vision can be demonstrated to be intrinsically rewarding. The goal would be to demonstrate to the client substantially better performance with vision. On the other hand, visually handicapped persons might not be making optimum use of information from other sense modalities. There is considerable evidence that among sighted persons vision will dominate redundant proprioceptive or auditory information even when the visual information is erroneous. Most of this research has been done with focal vision under conditions of good illumination, so it is not known if visual dominance would be as marked with peripheral or degraded vision. It seems quite possible that persons suffering gradually progressive deterioration of vision might still depend unduly on this less reliable vision. Such persons might need special training to utilize alternative
sense modalities in the absence of vision; specifically, to integrate information from two or more sense modalities. One approach is to train without vision, and then gradually incorporate vision back in. The empirical consequences of this approach are not yet clear. The goal would be to make the person as flexible as possible in his use of different sense modalities alone and in combination.

In considering the use of both visual and nonvisual information, is it enough to concern ourselves with detection of information? It would seem not. Shouldn't we be concerned with speed and efficiency of use? Excessive attitudinal demands in detection and processing may interfere with the task for which the information is relevant. One important criterion in mobility training might be the extent to which the use of a given type of information could become automatic.

An important aspect of mobility would seem to be the kind of representation of space a person could generate and how that representation might be manipulated. Typically, sighted individuals are able to take in a layout of space at a glance or in a rapid sequence of glances. They then can be shown to have a memory of the layout as a whole. Sighted individuals taught to go from X to A, X to B, X to C, etc., will induce the spatial relations between A, B, and C and will be able to go from one to the other directly. It is not known how much such an ability depends on having had visual experience. We do know that if the problem is made fairly complex and the information provided over a somewhat extended period of time, the induction of spatial relations is not nearly as good. It might be said that people generate route maps as opposed to spatial configurations. Route maps are workable for going forward or backward but not so functional for cutting across spaces or coming at them from different directions. Literature on the blind suggests that visual experience is important or facilitative in generation of spatial configuration representations. If so, persons with limited visual experience may find it desirable to have special training in generation of layout representations.

These comments have been directed towards static spatial layouts, but the general problem is as important (and even more psychologically complex) when some of the objects in the spatial layout are moving.

Generation of spatial representations is only part of the problem. The ability to manipulate these mental representations is also useful. For example, rotation of them is useful when approaching familiar spaces from different directions. The ability to change the scale of such representations might be useful in going from maps to spaces and vice versa. Little is known about the trainability of such capacities. However, it is worth considerable thought. Spatial representations are especially important for the visually impaired person. If he goes astray from an intended course and doesn't know exactly where he is, he will have to
keep an increasingly larger number of hypotheses in mind as he moves farther—unless he has an adequate mental representation that would assist him wherever he was.

**Early-intervention Training Suggestions**

As an example of the sort of program the mobility trainer might employ, consider first a visually impaired infant. If visual problems are suspected, there are fairly reliable techniques for screening infant vision. These employ visually-evoked cortical responses on the one hand, or behavioral preference tests on the other hand. If a visual problem is detected, a mobility-oriented stimulation program might be started. The goal of this would be to keep the infant actively involved in and learning about space in the same way a normally sighted baby would be.

The first step would be to provide the infant with enough general stimulation to insure the child being normally alert and sensitive to his environment. Thus the infant should receive considerable auditory, tactual, vestibular stimulation, etc.

The second step might be to provide the infant opportunity for generating his own stimulation. Bells or other noisemaking devices could be attached to his arms and legs. When the infant begins to grasp objects, noise producing dolls could be introduced.

The next step would be to extend the range of distance through which the infant could generate his own reafferent stimulation. Bower's idea of a focused ultrasonic beam with echoes reflected from objects made audible might be a possible technique. (This idea has only been tried in a pilot study and should be applied only with great caution.) The beam is projected from a head-mounted unit, and gradually narrowing the beam width could help instill the concept of directional senses. A visual feedback device coupled with the auditory feedback could be useful for getting the baby to attend to visual stimulation, and to integrate visual and auditory information. Visual feedback could be provided by having a light turn on, triggered by the sound beam, to mark an object. Alternatively, a head-mounted light could trigger a photo cell on the object—or simply a head-mounted light could be provided for the baby to play with in a darkened room. Again, this sort of stimulation might be useful for the concept of directional senses as well as for helping the child in the basic task of detecting visual stimulation.

Throughout such a program, general stimulation should be provided. A large component of this should be general and specific vocal approval. Infants are especially sensitive to vocal stimulation and the form of vocal approval could be especially effective.

After detection of simple objects is encouraged in the manner suggested above, the technique can be adopted to demonstrate the existence of multiple objects and to elicit object discrimination and identification.
by infants. That is, the infant would be reinforced for scanning back and forth between two objects. Then he could be reinforced for focusing on one as opposed to another object. A human-like object could emit a human voice and an inanimate object could emit other sounds. For example, a photoelectric cell on one object would trigger one voice when it was fixated by a head-mounted light beam, and a cell on a different object would trigger another voice when fixated. Reward could be contingent upon response to one voice as opposed to another. Alternatively, a flash of different colors could be triggered by a photo cell, and one color flash might be accompanied by a voice as reinforcement. The general goal is the creation of a responsive and differentiated visual-auditory environment.

As the infant begins to crawl, distance information in the feedback (e.g., changes of frequency with distance) would be particularly valuable. Distance discrimination could begin to be trained as well as directional crawling. Gradually, as the child travels more adequately, more and more complex spatial problems would be posed—detour problems, shortcuts, directional inputs, etc. In addition, localization of targets like up-down, front-back would be trained through discrimination procedures.

Most visually handicapped children are first seen formally by the orientation and mobility specialist at school age (occasionally preschool). Emphasis on the earlier-mentioned techniques of stimulation and reinforcement should be maintained, and further emphasis should be placed on training procedures that motivate the child (i.e., games and positive verbal reinforcement).

Initially, work should begin indoors in a controlled environment with emphasis on systematic familiarization with geometric concepts and spatial orientation. For lesson material on concept development and the training of visual efficiency, the reader is here referred to:


Visual Stimulation — Bulletin #227, Board of Education of Montgomery County, Rockville, Maryland; and


Reference is also made to the work of Burke and Efron. It is most important to stress work in basic fundamentals of near visual training in the development of visual efficiency.

While there are some differences between near and distance vision, there are many functional similarities. For example, localization in azimuth (projection) is important in reaching for objects in the near field or orienting the body in locomotion. However, differences exist in both scale and specific cue utilization.
In beginning training the instructor should be familiarized with a working knowledge of the developmental aspects of visual perception. An example of such a model is proposed by Getman.

1. A vague awareness of a difference in the visual field.
2. A generic object in the visual field (the "like" stage).
3. A specific object in the visual field (the "unlike" stage).
4. Object reorganization (combining and ordering like and unlike).
5. Search for meaning (what it is, what it is for, etc.).
6. Naming stage (identification).
7. Elaboration and expansion through visualization (beginning of concept).

When working with this or another model, it is important to keep in mind that training depends on a task at a particular time. The meaning of a perceptual configuration regarding teaching "what for" determines what features you point out to the student. The low vision individual is concerned with a variety of cues and landmarks such as shorelines, discerning of sidewalks from streets, signs, cars, obstacles, changes in terrain, curbs, slopes, driveways, pathways, etc. It is the knowledge of what to look for and what features are important for his particular task that instructors must teach the person to concentrate on. Entering an automobile, for example, requires identification of door handle contours, door opening contours, compressing the body to fit through the opening, etc. However, avoiding an automobile would stress changing size or shape of retinal image as auto approaches, auditory information of motion, tires, etc. and body movement to maximize image skew and avoid 180 deg symmetrical magnification. The useful information in reference to the cue thus varies incredibly. For example, a "particular" car may involve distinguishing color cues irrelevant to entering or avoidance. Detecting a break in the grassline on one day may indicate a need for change in one's route (i.e., turning and traveling up the pathway to a particular house) while on another day this cue may be insignificant to one's line of travel.

It is the orientation and mobility specialist's responsibility to point out critical features of cues and landmarks in the environment to enable the low vision individual to discriminate and make logical decisions about movement based on the limited information he is perceiving. To make these decisions, the person must know what he is looking for (i.e., purposeful as opposed to randomized looking, and selective as opposed to unstructured search patterns). To encourage selection of critical features, the student should be instructed to disregard the processing of less useful information and concentrate on the critical visual information on which decisions for further movement might be based.

The low vision individual must have his attention called to all options of a particular cue and know which options are most relevant to the purpose of his task or movement.
Training Suggestions for the Adventitiously Visually Impaired Person

What sort of perceptual training program might be feasible for adventitiously impaired older persons? The adventitiously impaired low vision student is likely to be a very different person from the congenital low vision student. He is likely to differ initially in his general cognition of space, mobility, and orientation although we would hope that these differences would be minimized for persons going through a program similar to that which we have proposed above. Secondly, a person adventitiously impaired must change his mode of processing information from one which has previously been simultaneous and parallel, to one that is to a greater extent sequential. Finally, travel for the adventitious person, once a “relatively carefree task,” now has become a relatively attention-demanding and perhaps anxiety-producing job. These changes, of course, are minimal for the congenital client.

In developing a program of training for the adventitious student, it would seem important to focus on the effects of his particular visual problem and adapt training to his particular needs. This would begin by making the person aware of the distortions produced by his visual problem. A second step could be to remind or teach the person to use specifically the information available in the visual environment. A third step would be to teach the person to attend to sources of information, both visual and nonvisual, which are available but which he might not have used before. Finally, it may be necessary to teach the student techniques for handling the change in information processing demands.

Specifically, the child or adult who has experienced a sudden loss of central vision often experiences various perceptual distortions of space. An object of interest can no longer be imaged on the macula and hence the lesser neurological resolution capability of the peripheral retina leads to a non-optical “blur” of the image. The low vision person usually interprets the location of this blurred object as further away, so that if it is moving toward him or he toward it, contact is made sooner than expected. Conversely, if this person is now fitted with a distance magnification low vision aid, the enlarged image of the object causes the viewer to localize the object closer than it really is. Movement toward the object results in contact being anticipated sooner than it actually occurs. Thus the adventitiously low vision person must learn to make adjustments to both of these oppositely directed spatial distortions.

If the central defect is large in retinal area and hence its angular subtense in space is great, objects may be temporarily “lost” when their ocular images fall on this non-functioning area and suddenly reappear with either their movement or the observer’s movement. If a low vision magnification device is prescribed it limits the peripheral field as well, so that essentially an annulus of intact visual field remains. Here a sudden disappearance or reapparance with either object or observer move-
ment, the so-called “jack-in-the-box” phenomenon, is observed. The jack-in-the-box phenomenon also occurs where annual, quadrantopic or hemianoptic peripheral field losses are present. The mobile low vision person is then deprived, in all of these instances, of his “early warning” detection system for objects entering this reduced periphery. The solution for these large field defects is to train purposeful eye, head, and body scanning movements to compensate partially for this reduction in available visual field.

A further complication in teaching mobility to low vision persons occurs from the individual’s own attempt to “correct” for such problems as central scotoma or nystagmus by eccentric fixation and head and body turns, tilts, or skews.

Since the oculocentric and egocentric straight-ahead direction has been firmly associated with foveal and macular projection before the central visual loss, such problems as inaccurate location and azimuthal projections of objects occur with eccentric fixation to avoid a central scotomatous area. Eye-hand coordination, reaching, grasping, eye-foot coordination and other visually directed manual and pedal activities often show discrepancies in execution.

Training objectives should be:
1. To establish an invariant, constant eccentric-fixation pattern producing best visual performance for a given person; and
2. To re-establish a new consistent relationship between eccentric fixation and eye-hand, eye-foot coordination. (The use of spectacle prisms allows the eyes to aim in the preferred direction with respect to the head and body, avoiding the awkward head and body positionings previously utilized to accomplish this. Such body skews, in addition to appearing unseemly and “abnormal,” tend to be fatiguing and to produce increased veering and weaving while walking with low-level visual cues.)

The adventitious low vision individual must shift from mobility strategies based on incidental learning and knowledge of layout of space to a more conscious, sequentially processed use of spatial cues in locomotion. An initial process of refamiliarization may therefore be in order, with the client’s attention being directed to visual and auditory information he has used all along, but may not have noticed, thought about, or verbalized.

The classical “cues” of space perception should probably be pointed out to the client, including:
1. Height in the visual field. Objects on the ground surface are egocentrically farther away as they are higher in the field. Objects on ceiling surfaces are nearer as they are higher in the visual field.
2. Texture gradients. Ground and wall surfaces having visible texture
can be used to judge relative egocentric distance. The denser the visible texture, the farther away the object. The more texture units occluded, the larger the object. This cue is relatively more useful in regular environments, especially man-made environments (floor tiles, paving slabs, etc.).

3. **Interposition.** The contours of nearer objects tend to obscure contours of farther objects. When the perceiver is unsure of which is which, the head or body can be moved back and forth producing visible "shearing," or covering-uncovering effects.

4. **Motion parallax.** Objects nearer the observer are displaced at greater rates across the visual field, while farther objects are displaced at lesser rates. This can be self-produced by locomotion, back-and-forth head or body movements. Fixation on the farthest visible object may help optimize this information.

5. **Shadows.** Shadows may be used to identify surface irregularities, objects on surfaces, or surface discontinuities, but shadows are variable cues, depending on the direction and intensity of illumination.

6. **The perceptual constancies.** Size constancy, shape or object constancy, brightness and color constancy, velocity constancy are likely to be important topics to discuss with the student.

7. **Time-intensity differences.** Time-intensity differences in binaural stimulation may be described to the client so he understands this basis for locating a sound-source, and its possible use to "home in" on it to within visual range for identification.

8. **Flow patterns.** The fact that there is a continuous optical "flow" from a "focus of expansion" as we move may be useful in visually guided travel toward various targets. As we change targets, the focus shifts. In central scotomas, a "black hole" may be used as a focus of expansion—the point from which the visible flow emanates.

9. **Size-shape changes in locomotion.** In addition to noting the non-changing aspects of remaining visual experience (the constancies) the changing aspects can be pointed out—those which specify or indicate motion of an object toward, away from, or past the person, and those which indicate motion of the observer toward, away from, or around objects or places. Motion pictures or other "stimulation" techniques may be ideal vehicles for drawing the student's attention to such potential information.

The adventitiously visually impaired person also has an information processing problem. Large amounts of information which were previously absorbed simultaneously and unconsciously or incidentally now must be taken in sequentially and intentionally. This is particularly the case with spatial information. Previously we noted that it is important to teach scanning strategies. Now it is probably necessary for the student to
develop systematic storage and memory techniques. For spatial layout it may be helpful for him to try to place the information into something like a visual image or two dimensional representation. In actively searching for spatial information and for its storage, it may be useful to relate information to specific reference points or coordinate reference systems. If this is habitually done, the information might be provided through residual vision, tactual-proprioceptive exploration, or verbal (auditory) description.

Motion Pictures

A possible technique for supplementing low vision mobility training and introducing the client to critical perceptual information is the use of motion pictures. Films of indoor and outdoor environments in both static and dollying modes, back projected on a large back-projection screen via an analyzer projector incorporating stop frame, controlled-rate presentation, and zoom lens allow the student to be introduced to visual information he will be using in actual mobility. The advantages of such a technique should be several—

First, the mobility specialist can be sure there is clear communication as to what is meant by particular contour shapes, interposition, locomotor flow information, etc., by using a controlled, slowed, stopped, or repeated film presentation.

Second, the student can use motor responses (e.g., with an arrow pointer flashlight) to indicate objects, contours, or areas to the mobility specialist, with immediate correction and feedback when confusion remains.

Third, environments can be previewed in “off-season,” to establish what a route or markers along that route will look like when covered with snow, in rain, the trees with or without leaves, etc.—“films for all seasons.”

Fourth, the zoom lens projector feature allows magnification of details or areas without using head-mounted optical aids. This ties in with perceptual learning principles of accentuating or amplifying critical features which differentiate among objects, category memberships, or locomotor flow patterns.

Fifth, a step-by-step introduction of visual perceptual cues is possible prior to the complexity of actual client mobility—e.g., the mobility specialist can show the low vision trainee what it will look like to approach a wall, enter a building, cross an intersection, with the possibility of “time expansion” in early training stages, to be gradually collapsed to “real time.”

And, finally, specific familiar local environments can be used in films to introduce clients to difficult mobility situations in low-anxiety and controlled conditions.
While there are a number of filming techniques for producing such films, a relatively inexpensive setup could include a camera dollied via a motor-driven wheelchair for travelling shots, and hand-held for up-down situations. A motor-driven 16-mm system is preferable (higher resolution for magnified viewing), but a Super 8-mm system would be even less expensive.

We know of no evaluation of such perceptual training for low vision mobility, but the theoretical and practical advantages of such perceptual previewing are worth pursuing. General guidelines for perceptual training might include the following principles:

1. Training should be centered on tasks which are as close as possible to the goal perceptual functions. While some standard perceptual training programs may be useful, very often the training tasks are far removed from the criterion performance.

2. Where the training task does differ from the actual real-life performance, attention should be given to generalizing the things learned from the training situation for use in the real environment. One way of doing this would be to move the child back and forth from the training to the natural situation.

3. It is often useful in perceptual training to begin with exaggerated differences in the critical stimulus dimensions and reduce these differences as training proceeds. Sometimes it may be useful to accentuate a particular stimulus dimension's critical property by adding redundant information (e.g., color coding information). However, caution should be used in doing this because the child might become so dependent on that information that his performance would fall apart if it were removed.

Recommendations in the form of guidelines for the future were made by the group (Group 2) whose report appears above. Their recommendations will be found under the heading "Recommendations from Group 2, Concerning Visual Training without Aids" on page 119.
Introduction

The subject of low vision mobility is one with which practitioners in orientation and mobility are necessarily familiar, since up to 80 percent of all clients receiving rehabilitation services have some degree of residual vision.

The content of this section is based primarily upon experiences in low vision clinics. All statements related to training, and to the integration of low vision systems into the lives of clients, draw upon combined low-vision-clinic and general orientation-and-mobility teaching experience.

Material in this section relates specifically to the role of distance aids and the teaching patterns necessary to permit integration of these aids into the life style of people whose visual efficiency can thereby be enhanced.

Prior to the discussion of specifics, it is appropriate that we review the operative factors in low vision mobility. This look into the nature and scope of the problem can aid in developing the kind of team approach to low vision which seems to be essential if clients are to receive maximum benefit from low vision services.

Part One: Establishing a Low Vision Perspective

The Individual in Society

Regardless of where we live or what forms our various life styles take, certain relationships and tasks are common to us all. We live somewhere, usually in a building which is oriented in some manner to a street. Most of us live with other living things, people or animals or plants, all of which require some degree of nurturing. We work, read, play, eat, shop, travel, and talk. Our lives are remarkably visually defined regardless of whether we see "normally," not at all, or to a limited degree.

Nearly all of us use optical aids in the performance of certain life tasks, the most common being ordinary house lighting. However, since it is not characteristic of the human condition to see in the dark, lights are referred to as utilities and considered the norm.

So, too, increasingly are prescription glasses or contact lens wear characteristic of many population groups.

Due to myriad medical and optical factors a great many people are unable to perform necessary life tasks at near, intermediate, or distance without the use of a corrective prescription.

Persons who are able to go about their lives working and playing with the help of corrective lenses, readily available through local ophthalmologists' and optometrists' offices, are not usually considered to have
low vision. This is true even of those who are seriously visually impaired without glasses, and those who require more than one prescription (i.e., bifocal, trifocal). The significance appears to lie in the ability to perform most life tasks with visual efficiency, while maintaining a typical cosmetic appearance in terms of visual aids required to do so.

Conditions Imposed by Diminished Visual Perception

As the capacity for visual perception is diminished the possibility of performing the multiplicity of life tasks in an unobtrusive manner is decreased. The reasons for diminished visual efficiency are almost never simple and may be due to several interrelated factors. Whenever visual insufficiency can be corrected by general medical-surgical or refractive procedures the individual is usually not considered, nor considers himself, visually impaired. Additionally, individuals may experience some degree of reduced ability to accomplish visual tasks—threading needles, reading fine print or small signs at distance—as an inconvenience to be tolerated in the process of growing older.

It is usually within the context of the inability to perform major life tasks satisfactorily that people begin to consider the possibility of visual impairment in themselves or loved ones. Adults may note that driving even in the daytime becomes hazardous, features of friends and family become indistinguishable, reading and looking at photographs becomes impossible, activities at a distance become a blur and so on. A baby may not seem to notice the presence of a colorful object at the same distance his brother did, or a young child may hold his books “too” close.

At times the occurrence of one or more specific visual problems provides motivation for the visit to the ophthalmologist or optometrist. At other times a diagnosis may be made before symptoms of visual impairment are noticed by the family and the individual. In either event the recognition of visual impairment is stress related. Concerns for the future predominate, and frequently the individual—more often the family—is unable to establish a true perspective of the problem.

Approaches to Resolution of Life Problems Incident to Low Vision

It is not surprising that complex problems stimulate diverse solutions. The approaches to problems incident to visual impairment tend to reflect the frame of reference of the problem solver as well as the nature of the problem itself. A very essential and basic approach is the attempt to eliminate or control the source of the problem as seen in medicine and psychiatry.

Modification of the Environment—Increasingly in our society a concern for handicapped people is being reflected in attempts to structure environmental features in a manner which will provide maximum safety and
optimum performance. White crosswalk lines, obstruction-free exterior building lines, good interior lighting, and clutter-free store aisles are examples.

The lengths to which city planners and engineers, etc., are sometimes willing to go to assist the physically handicapped exemplify good, if not always pragmatic, intentions. For example, suggestions have been made that street-crossing bars be set at intersections and that an auditory component be added to the traffic light to notify pedestrians who cannot see the light change that it is safe to cross.

Modification of Life Tasks and Expectations. – Perhaps the most common approach to resolving problems incident to visual inefficiency on the part of individuals with visual impairment, and especially their families, is to modify life tasks and expectations. Household, grooming, and related activities may be reassigned. Employment may cease due to the inability to perform certain tasks or because the physical safety of the individual is considered to be in jeopardy.

Frequently many life tasks are eliminated or curtailed because of visual difficulties. In addition, the patient or family members may force a curtailment of activities as an overreaction to the visual impairment. These misguided intentions may lead to a situation where an individual who is no longer able to drive is also prevented from walking alone. Personal and business tasks are increasingly taken over by others and on occasion employment may involuntarily cease.

We can’t know for sure how many people who could be helped by low vision aids and training have remained unaware of low vision and other rehabilitative services. The number is undoubtedly large. Programs to familiarize the entire special education and rehabilitation field with low vision programs will increase the exposure of clients to these services.

Acceptance of and Adaptation to Altered Visual Circumstances.—Especially in the years since World War II, the possibility of learning to deal with the reality of visual impairment, and to acquire compensative and adaptive skills designed to permit performance of necessary and desired life tasks, has been available in formalized training program (i.e., Hines Blind Rehabilitation Center — Veterans Administration Hospital).

For too long visually impaired and totally blind clients were tutored similarly, regardless of the functional nature and stability of their respective visual impairments. People who could read print learned braille and many who could navigate the environment visually learned to travel with a long cane.

In recent years a different approach has become prevalent. A trend toward a more pragmatic approach to low vision in rehabilitation settings, together with availability of specialized optical systems, has re-
sulted in a significant increase in visual efficiency for numerous visually impaired people.

Essential to the improved effectiveness of services for visually impaired people has been the attempt to individualize rehabilitation programs to meet specific client needs and capacities. Of equal importance has been the—as yet incomplete—movement toward coordinated efforts on behalf of those involved in the various aspects of dealing with the low vision client.

Need of a Team Approach to Low Vision Services

Just as the consequences of diminished visual perception are far-ranging and diverse, so too, are its causes. Generally, complex and often interdependent medical and optical factors are involved in the low vision experience. To these intricate causal factors must be attached the psychosocial milieu in which individuals and society react to impaired visual functioning (and to potential visual impairment in the event of early diagnosis of a progressive pathology).

Successful implementation of low vision services depends upon the ability of the service personnel to recognize, understand, and deal with each of these interdependent operative factors.

It will be readily apparent from the complex nature of the problem that no single discipline or area of expertise is capable of coping with all facets of low vision. Coordinated effort on the part of medical, optical, and other personnel is essential to integration of appropriate low vision systems into the life style of needy individuals.

It is perhaps to be expected that the varied disciplines and areas of expertise, composed as they are of individual human beings, should be somewhat ethnocentric in outlook.

Other ages have had their Aristotles and Jeffersons but our own is blessed with experts for each of the diverse facets of human experience. There is no longer a need for, nor some would say the possibility of, one discipline doing it all. Each member of the team functions in his own area of expertise but within the framework of a coordinated rehabilitation plan for the client. Different individuals can function as the coordinator of the patient’s rehabilitation program, depending on the problem areas being considered. (For example, if development of mobility skills is a major objective for the client, the O & M instructor will exert maximum influence for this case.)

The environment in which the low vision clinic is housed appears to be of secondary importance to the makeup of the low vision team providing the service. An effective working relationship among the various members of the therapeutic team and a well organized procedural operation to carry on the business of the clinic is certainly possible alike in a university, hospital, rehabilitation or blind-rehabilitation setting. Each
of these locations may be expected to have advantages and disadvantages. Clients with a high degree of residual vision may be more comfortable in a hospital or university setting. Clients needing training in non-visual techniques can receive a coordinated program of service in a clinic located in an agency for the visually impaired. The important factor is that the service is provided in an interdisciplinary setting and not isolated from a team concept.

The Ophthalmologist. — Basic to low vision services is the need for accurate and complete medical diagnosis and treatment both ocular and systemic. All members of the low vision team need to be aware of the relationship between specific eye pathology and what to expect in terms of retained useful areas of vision and stability. The logical source for this information is the ophthalmologist. Additionally, visual disorders are frequently associated with or secondary to major medical conditions such as diabetes and hypertension. The in-depth medical frame of reference available through the ophthalmologist is invaluable to other members of the low vision team.

The Optometrist. — The optometrist brings to the low vision service expertise in physiological optics and refraction techniques. In many low vision clinics the optometrist assumes the role of team leader, conducting the low vision examination, recommending appropriate low vision aids and helping training personnel sort out specific problems as they arise in client training and usage. The important tasks of working with the consultant ophthalmologists and helping family members understand the visual abilities and needs of low vision clients can be appropriately handled by the staff optometrist.

Administrator. — The day-to-day management of the low vision clinic requires both a forward looking and a flexible policy of operation, and careful attention to specific details. Harmony between program development and efficient business procedure is not easy to achieve. This is especially true of an interdisciplinary service like low vision which requires expensive equipment and highly trained personnel in order to operate. The administrative role of working together with the program people to achieve maximum efficiency of client and payment flow in the presence of high-quality low vision services is an important one.

Teaching Staff. — The experience of low vision clinics over the years has validated the need for training clients to handle effectively, and adapt to, recommended low vision aids. Background and low vision training of teachers of low vision varies in clinics providing this important service. Nurses, social workers, teachers, and orientation and mobility instruc-
tors serve various clinics with apparent success. The most important teaching prerequisite would seem to be an ability to deal with people in stress situations. Understanding of the scope and limitations of the respective low vision aids can be improved through closer communications among members of the low vision team.

Supportive Services

Reading Skills Specialist. — Clients who have never learned to read, or who can read again only with difficulty through high magnification lenses, require tuition from someone knowledgeable in teaching basic reading skills.

Orientation and Mobility Instructor. — Similarly, clients who have difficulty ambulating visually need to be evaluated and taught to use distance low vision aids by an orientation and mobility instructor (peripatologist).

Social Worker. — Trained social workers can be of significant help in helping low vision clients and their families deal with adjustment problems and also in assisting the low vision clinic to optimize funding and community supportive services.

Group/Individual Therapy. — Many clients have experienced significant difficulty in their interpersonal relationships as a consequence of visual impairment. Others feel that social and vocational problems derive entirely from reduced vision when the visual problem is of a secondary importance. Some clients who have formerly been severely visually impaired are significantly helped by low vision aids yet have trouble dealing with the enhanced visual input and/or rising performance expectations. Several major therapy groups can be identified:

1. Partially sighted adolescents.
2. Visually impaired persons, previous braille readers and/or cane travelers, who now have improved visual performance, concomitant with rising performance expectations.
3. Clients with seriously regressive conditions, especially those which have been recently diagnosed.
4. Geriatric clients.

These services are best accomplished by utilizing the expertise of psychologists and/or psychiatrists. Other disciplines may provide these direct services with appropriate consultation.

Part Two: Low Vision Mobility with Optical Aids

Initial Orientation and Mobility Evaluation

The orientation and mobility instructor can provide information per-
tinent to the clinical evaluation and eventual prescribing for the low vision patient:

1. Are there physical limitations to the patient's ability to be mobile?
2. What are previous experiences of the client that are related to clinical testing situations?
3. What specific day-to-day tasks does the patient report difficulty with? (i.e., What are the reported needs?)
4. How does the person function in the environment (tactually, visually, etc.)? Are there apparent problems that the client did not report?
5. Are the client's concepts of direction and laterality adequate?
7. Assessment of visual performance at a variety of viewing distances and in a variety of environments (residential, business, etc.).
8. Are significant head or eye movements used by the client to perform visual tasks?
9. How well does the client use auditory cues in conjunction with visual performance?
10. What are some potential problems that will be faced by the client in the actual mobility instruction program? Are optical aids a potential source of reducing these frustrations or overcoming the problems?
11. What is the subjective evaluation of the patient's motivation to work with aids and to undertake training?
12. How does the client use present aids?
13. Is the client provided with an explanation of the examination so that comfortable, realistic expectations are brought into the examination room?

Clinical Low Vision Examination

Medical Evaluation.—It is important that all members of the low vision team be informed of any (and all) areas of intact retina and what can be expected in terms of visual functioning in those areas. Indications of the progressive or stable nature of the pathology should be provided. Recommendations for medical/surgical treatment programs should be made in coordination with the remainder of the rehabilitation team's perspective/training services.

Comments on fluctuation of vision due to medications or systemic conditions such as diabetes should be provided for the rehabilitation team.

Visual Acuity.—There is a need for standardized visual acuity tests at distances compatible with low vision performance and broken into numerous small gradations (i.e., 10 ft, 5 ft). Materials meaningful to the individual should be used for testing. Instructors should know under
what levels of illumination testing was performed so that it becomes a more meaningful baseline measurement.

Consideration must be given to the presence of refractive errors, ability to track, fixate accurately, and to the integrity of the binocular system in focusing and moving the eyes together. Eye-hand coordination and the matching of visual and auditory inputs needs to be investigated.

Visual Field Studies.—In view of the significance of peripheral vision in performance of mobility tasks it is important that low vision services include complete visual field studies. Clients with significantly less than 20/200 visual acuity may require adapted visual field studies including large targets. Awareness of the presence and location of field defects is important in assisting clients to perform orientation and mobility tasks. The location of central field defects can drastically influence near visual performance as well as distance.

Illumination.—Varied lighting conditions are common to mobility task performance. In many instances the occurrence and sequencing of shadow, bright lights, semi-darkness, etc., cannot be controlled and clients must be ready to cope with prevailing lighting conditions. Knowledge of the detrimental effects of illumination changes on visual acuity must be taken into consideration in the development of orientation and mobility skills. This is particularly true of our geriatric population (McFarland, Domey, Warren, and Ward; Slataper; Wolf). Deterioration of acuity and fields with changes in illumination, and the effects of glare, should be reported to the orientation and mobility specialist.

Magnification Evaluation.—The amount of magnification needed by the patient to perform specific tasks is determined. Optional devices for providing this magnification (telescope, contact lenses, reading aids, etc.) are indicated. The most appropriate aid (based on clinical and functional data collected up to this point) is recommended. Further evaluation of the effectiveness of the aid in solving the patient’s performance problems is conducted during the training program. Appropriate modifications can then be made, based on these observations.

Low Vision Clinic Policies Regarding Prescribing and Dispensing Low Vision Aids and Systems

1. Prescription of specific low vision aids to clients needs to be on the basis of medical and optometric findings and functional vision requirements. It is necessary to determine which specific aid can most benefit the client.

2. Experience has reinforced the policy of initially recommending
the simplest aid that will do the job.

**General Guidelines for Distance Vision Aids Training**

1. **Whenever possible begin with the most desired visual tasks using the simplest of the recommended low vision aids appropriate to the tasks.**

   Frequently, television viewing, reading the chalkboard, reading house numbers and street and business signs, have high client priorities. These are appropriate beginning tasks because they permit the client to locate and examine stationary objects from a sitting or standing position of his choice. It is desirable that initial work with distance aids be with the client sitting near a table (the table provides a convenient arm rest). It is helpful if the object to be examined is either grossly visible to the client without the aid, or contrasts well with the visual background.

   Sometimes the most desired visual tasks of clients involve complex handling and tracking tasks. Watching a child play in the yard, observing passing scenery from an automobile, watching a basketball or football game must be preceded by successful location of single targets by way of systematic scanning techniques and developing an ability to track predictable targets, (e.g., locating a stationary family member and tracking him as a moderate walking pace is begun).

2. **Start with simple visual environments.**—It is difficult to overstate the importance of basics when introducing clients to low vision aids. Clients utilizing eccentric viewing must be aware of how to look at objects most visually efficiently. During fitting of low vision aids and systems, and throughout the training process, care must be taken to ensure that the fit of the aid and placement of the lens coincide with the client’s optical/visual requirements. This is especially true of spectacle-mounted telescopic lenses.

   Simplicity of initial visual environments is required, especially for clients with very minimal residual vision and/or aged and inflexible clients. Locating a large clock (or other common objects) on an uncluttered wall of contrasting color is a suitable initial task. Locating the same clock on a window wall cluttered with pictures and high furniture would not be. Similarly, initial work with reading distant signs and numbers needs to be introduced in visually simple environments free of congestion: it is generally inappropriate to introduce use of distance aids to accomplish these tasks within the context of a mobility run, where the objective is to go from a starting point to a destination.

3. **Build upon each learning sequence.**—Each sequence in the learning experience can serve as a stepping stone to the next. The task of locating a clock on a wall serves as an introduction to systematic scanning with distance aids. Since the target is near the ceiling the concept of vertical
scanning can be introduced by using the ceiling as a reference point. Build upon the preceding task. This can be done by using the aid to locate a television set using the baseline of the wall as a reference.

*Television viewing* is an effective means of getting used to the magnification characteristics of the aids. The instructor can utilize this telescopic field of view as an indication of viewing distances and scanning needs for observing other distant objects. Asking the client to locate the television by intentionally scanning, rather than looking where it should be, introduces the concept of relating objects to one another in space in addition to providing practice in horizontal and vertical scanning techniques. The next sequence to build on is to teach the client to relate to the outside environment (i.e., identify position of curbs, street signs, house numbers, etc. in relation to other objects).

Success can depend upon enabling clients to associate basic learning experience with their personal goals. Enlisting family members to serve as usual targets works (as long as the family relationships are congenial and the helpful member realizes the importance of making the task relatively easy at first). Additionally, using birdbaths, trees, flowers, etc. as practice targets, especially if the client can do similar practice at home, makes an enjoyable experience of basic learning sequences.

A very important factor in initial work with a low vision aid is to provide enough structured repetitive practice using the aid so that the trainee not only gains proficiency with it but overcomes some of the shyness inherent in looking about the world through something that appears peculiar. These initial structured learning experiences must occur in the clinic or center setting.

4. **Have a team consultation without delay.**—When low vision aids and systems seem unable to permit performance of desired visual tasks for which the aid was recommended it is important to have a team consultation without delay. For example, the client may not be able to read the bus destination or street sign at 50 ft as anticipated but only at 5 ft distance. Or the client may be able to read the 10/160 line on a Distance Test Chart for the Partially Sighted in the low vision clinic—but be unable to function visually with the aid in performance of training and daily life tasks. Something is wrong and it is important to find out what, and if possible, why. At these times a team approach to low vision services is indispensable. The instructor can note the specifics of the problem and sometimes hypothesize a solution. The doctors can make appropriate recommendations for solving the problem based on the teacher’s input (i.e., medical, optical, psychological).

*Understanding the Characteristics of the Distance Aid*

Successful utilization of a telescope requires the patient’s understand-
ing of the following parameters. (It is also mandatory that the instructor know the purpose for which the aid was prescribed and when it should be used.)

1. The telescope does have a restricted field of view. This restriction usually increases with greater magnification. The instructor should look through the telescope for each specific task the student is to learn to perform. Compare observations with those of the student.

2. Typically, people may not adapt to the constant use of a telescope due to spatial distortions. Thus, telescopes are usually prescribed as a spotting device in hand-held form. Some people have adapted to distortion of depth perception and movement created by the telescope and are able to wear it for full-time use including ambulatory purposes. These people can wear full-diameter spectacle telescopes or contact lens telescope systems. The bioptic telescope where the client can use conventional lenses for most viewing activities and use the miniaturized telescopes mounted in the upper portion of the lens for detailed spotting is an excellent compromise aimed at overcoming problems of adaptation to telescopic magnification and need for full-time general wear. (Bioptic telescopes will be discussed later.)

3. Eye-Aid-Object alignment is difficult especially in the presence of nystagmus, eccentric viewing, palsy, unsteadiness, etc. These difficulties may be minimized by:
   a. Using clip-on telescopes where unsteadiness and palsy are major problems. These telescopes clip into conventional spectacles worn by the client. They are easily removed.
   b. Insuring that the student is using the aid correctly by having him describe what is being seen through the telescope.
   c. Starting localization training using large objects and having the client sit with the elbows against the body or resting on the table.
   d. Using a sturdy object to steady oneself with when standing and viewing.
   e. Painting a white ring around the ocular allows for easier location of the viewing tube by the client.
   f. Locating and using the position of gaze which results in the least amount of nystagmus (null point).
   g. Guarding against slippage. Often the weight of a clip-on telescope will cause the spectacle to slide down the nose (increase cornea-ocular distance) and create client discomfort. An athletic headband attached to the spectacle will decrease slippage and discomfort.

4. Make sure the client knows how to focus the telescope.

5. Make sure the client knows the ranges of clear focus for the particular telescope. Most telescopes do not focus to 8 ft or closer without additional lenses or large amounts of accommodative (focusing) effort on the part of the patient; this will quickly fatigue the patient. This
may be used as an indication of inappropriate focusing of the telescopic unit.

6. Field of view of the telescope is maximum when the ocular of the telescope is at the corneal plane. The client should be taught to hold the telescope as close to the eye as possible to enjoy the maximum field of view. If the telescope is held against a plastic spectacle lens, a felt pad placed on the ocular housing will reduce scratching.

7. A bioptic telescope consists of a conventional plastic lens with a small circular hole drilled in its upper portion. Usually a small 2.2× or 3.0× telescope is mounted in this hole. It is high enough not to interfere with the patient’s normal gaze. When the low vision patient wishes to use the telescope, the head is tilted down slightly and the eyes move upward into the oculars of the telescopes. Now a magnified image is presented to the patient. The telescope must be mounted directly in front of the eye(s) if a full field of view is to be appreciated or, in the case of two units, if binocular vision is to be enjoyed. Poor alignment of the telescope(s) with the center of the pupils of each eye results in decreased visual function. As with other telescopes, the frame must keep the units as close to the eye as possible to provide maximum field. Thus, proper alignment of the frame must be maintained. The units are angled slightly upward to compensate for the slight head tilt when using them for viewing distant objects. If both units are not tilted equally, binocular vision is impossible. Too much tilt will result in exaggerated head tilt to use the device.

8. Reversed Telescope.—The use of a reversed telescope provides an increased field of view but does reduce the image size the same amount the fields are increased. Depth judgments, etc. will have to be relearned. It must be treated the same as a routine telescopic prescription.

9. The contact lens is another distant-vision aid. It is used to correct high refractive errors because it can provide better acuities through improved optics, and larger fields of view are typically enjoyed by the client. Some areas of concern for the training of the client are:
   a. The client must know how to insert and remove the contact lens easily. The techniques (especially removal) should be familiar to the mobility instructor, rehabilitation instructor or special-education instructor involved with the student. Special techniques may be needed to train the individual to accomplish this seemingly simple task.
   b. The stronger lenses will often slide off the central cornea and will need repositioning. This is sometimes difficult for low vision patients to accomplish and instructors may be called upon to reposition a lens. (A lens cannot be lost in the eye. There is a closed cul-de-sac to retain the lens.)
   c. Appropriate hygienic practices must be maintained by the contact
lens wearer. The instructor should be familiar with these practices (especially for soft lenses) and be able to identify those clients not taking proper care of their lenses (i.e., dirty cases, fingernail-scratched lenses, etc.).

d. The contact lens telescopic system consists of a very strong minus contact lens (ocular) in conjunction with a moderately strong spectacle lens (objective). Problems in alignment of these two lenses can disrupt visual acuity improvements temporarily. A poorly adjusted frame will move, increasing the cornea-lens distance, and change the focusing power of the telescopic system. The telescope will focus closer to the observer as the spectacle lens slides down the nose (increased cornea-lens distance). This technique can be used intentionally by the patient to observe objects at varying distances.

10. The advent of the Fresnel (membrane) prism has increased the examiner’s armamentarium of devices to be used for distance vision. Their uses and limitations are as follows:
   a. Prisms are used to move the patient’s eye to the null point in nystagmus. Acuity can be improved with this system. Since this is a difficult position to ascertain, the instructor must be able to evaluate performance changes and nystagmus reductions with the prism in place.
   b. Gross head-turns due to eccentric viewing can be eliminated with prisms in the same manner. The client may have to learn to see with normal head posture. There will be a tendency to move the head to a customary position.
   c. The Fresnel lens is durable but not permanent. The client is taught special cleaning procedures utilizing contact lens cleaning solution, and lint-free cloths. Decreased visual acuity will result if proper cleaning techniques are not maintained.
   d. Air bubbles cause significant reductions in acuity. This is corrected by reapplying the membrane. This is something the instructor can and should be taught to do, if the patient is not capable of doing it alone.
   e. Strips of prism lenses are used for people with severe field losses. The lens allows an individual to compensate for the field loss through small eye movements into the prism instead of large head turns into the defective field. The prism allows the individual to be “aware” of objects in the defective portion of the visual field. Proper alignment of the frame, positioning of the membrane on the spectacle lens and appropriate cleaning of the membrane are important in maintaining maximum optical benefit from these devices.

11. Illumination control systems (sunglasses) are frequently used to improve distant vision. Comments on the use of this method include:
   a. Illumination needs vary, and multiple prescriptions may be
needed. It is possible to have sunglasses which transmit 50 percent of the light impinging—or 1 percent of the light. The indoor lighting, or weather, may determine which lens is needed and when.

b. Some people are so sensitive to light (photophobic) that small rays of light entering past the side or top of the frame are like searchlights burning out the retina. Use your imagination and cover up these light sources. Sometimes wearing a sungoggle over a sunglass will be the solution to the problem. The client must be willing to use several spectacle sunglass prescriptions if necessary to maintain a stable level of visual performance.

12. General taped instructions can be given to the client on a cassette tape. This will refresh the client's memory as to the appropriate use of the aid after he leaves the clinic.

Comments on Durability of Distance Aids

Some participants felt one might encounter problems with the Selsi clip-on monocular. Screws may be lost and the carrier for the interchangeable lens is sometimes not smoothly threaded. The clip-on attachment may not rest smoothly over the spectacle frame. Clients sometimes find that the weight of the clip-on aid tends to pull the frames down.

One will also encounter the problem of a frame-mounted telescopic lens becoming detached from the carrier lens, or a reading cap coming off the objective lens of the telescope.

The durability of the Bushnell 6×8× monocular was reported as quite impressive.

Since rather simple mechanical problems can render aids useless, it is important that manufacturers use every care to avoid minute and easily lost components. However, since they do not always take this into consideration, a supply of extra components such as set screws would facilitate making repairs.

Adaptive Training with Distant Low Vision Aids

The objective of the training program is to help the student achieve maximum visual efficiency through the integration of the low vision aid into the student's life tasks. In using the distant vision optical aid, the student must reestablish previously learned (i.e., concept developments without aids) orientation skills. Scanning, tracking and spotting skills, as well as reestablishing depth perception, distance judgments, hand-eye coordination and form-size perception, are all features which must be used effectively by the student for the reestablishment of these skills.

Most often clients require structured practice over a period of time to utilize low vision aids and systems effectively. Experience indicates that very specific verbal and even print information does not minimize
misunderstandings and frustration. When more than one aid is prescribed, the various aids should be introduced at appropriate points in the training program.

The use of telescopic systems and Fresnel prisms lends itself well to the following adaptive training techniques:

1. *Initial view.* — Have student view familiar objects through the telescope to present to the student the visual distortions inherent in magnification.

2. *Locating objects.* — Initially, learning experiences need to occur in controlled, visually simple environments with the client stationary. A basic learning task is to locate selected object targets. Subsequent learning tasks involve development of horizontal and vertical scanning techniques.

These training techniques have been discussed previously. It should be noted that any natural horizontal or vertical landmarks can be used for this aspect of training. In fact, as many different cues as possible should be utilized in this training program.

A technique to reinforce localization is that of drawing lines on a piece of paper; or, using a distant or near telescope, have the student trace or track lines on the paper through telescopic magnification. This also reinforces hand-eye coordination. A simple maze pattern could be used for this purpose.

3. *Tracking.* — Once the client can effectively locate stationary object targets, tasks involving tracking of moving objects can be introduced. It is helpful if the first tracking exercises involve a person who begins to walk slowly towards the client from a standing position.

The concept of free body space may be introduced as a variation in tracking exercises. The client, sitting or standing is bypassed by a person moving parallel, perpendicular, diagonally to him. Verbal and tactual cues are used to help the client interpret the true position. These sequences lead naturally into adaptation to the distance distortion inherent in telescopic systems (exaggerated motion).

As the client develops proficiency within controlled, visually simple environments, lessons can begin in controlled indoor and outdoor settings free of pedestrian and motor congestion. Subsequent learning experiences can utilize environments of ascending visual complexity and pedestrian and motor congestion. (Complexity is to be kept appropriate to the students’ development.) This will hold true for all of the training techniques discussed.

4. *Scanning.* — The client must learn to develop scanning techniques utilizing movements of the head and body, and to integrate these movements into an effective system of gathering information about the environment. This skill is developed by having the client find several
widely separated objects in a room, spaced in such a manner that head and body movements are needed to locate them. Having developed these skills with the distant aid, the student can then be involved in routine orientation and environmental cue concepts found in the mobility and orientation program.

5. **Ambulation.** — Once the client has been able to relate visually to moving objects from a stationary position, positions can be reversed with the client moving up to, about, parallel, diagonally, etc. to stationary objects.

Initial ambulation experiences can be guided by the instructor, long-cane users may want to use the cane in conjunction with the aid for confidence. This allows them to concentrate on visual input.

Subsequent learning experiences can utilize environments of ascending visual complexity, and pedestrian and motor congestion.

**Duration of Lessons and Length of Training**

Initially 3 to 5 minutes work with the telescopic system should be followed by a rest period. The time can be gradually increased as the client experiences no “complications” (dizziness, nausea, equilibrium problems, etc.).

Contact lenses and spectacle prescriptions for high refractive errors usually result in such a significant improvement in acuity that the spatial distortions (aberrations, flat field, jump) are easily adapted to. Full-time wear is the best training technique. Some feedback on hand-eye coordination and advice as to potential mobility concerns should be given. Appropriately designed lenses will minimize these problems.

The overall training period must be expected to vary with the individual circumstances. Findings indicate effective distance discrimination (in terms of free body space) within 1 hour of actual training. A 1-month period of daily training and independent practice can enable certain students to perform a wide variety of tasks.

**Followup**

Coordination with school and rehabilitation programs is essential to successful integration of these sophisticated low vision systems into the individual’s behavior pattern.

Upon completion of formal training, followup at 1, 3, 6, and 12 months is recommended. Followup should consist of some minimal functional evaluation: this should include reevaluations by the low vision team. With all these procedures it is important that:

1. Scheduling be specific;
2. Goals and difficulties are reviewed;
3. Sufficient time be allotted for training;
4. Instruction be provided as often as needed.
Controversy abounds regarding the role of telescopic systems in low vision mobility. Experience (Safety Management Inst., 1975) provides substantiated evidence that clients can adapt to the visual distortion inherent in the use of telescopic systems during ambulation to accomplish the tasks of the pedestrian.

There are current investigations on the possibility of applying the approach of Jose and Butler (1975) to enable clients (20/100 visual acuity at 20 ft) to regain a driver’s license. They would use a telescopic lens to spot traffic signs and signals at a distance only.

Critical to the role of telescopic magnification or minification systems in ambulation are not only the possibility or impossibility of adapting to inherent perceptual distortions, but also the relationship of detection to reaction time. As visual inputs are diminished, due to restricted visual acuity and fields, information processing becomes both more difficult and more time consuming.

Enhanced visual acuity or field provided through telescopic systems must be interpreted in terms of translation time required to process incoming information. This is a significant factor in tasks of the pedestrian and increases with speed of ambulation (i.e., standing, walking, running, cycling, driving).

The human machine appears capable of tolerating an extraordinary amount of ambiguity — of functioning effectively in the presence of perceptual distortions.

In addition to a carefully structured training program, several student characteristics appear to be significantly related to the successful outcome of attempts to ambulate with telescopic systems:

1. **Motivation.** Keen desire or need to accomplish a task frequently prompts the practice necessary to develop basic skills prerequisite to proficiency.

2. **Flexibility.** Students vary significantly in their ability to tolerate ambiguity and cope with altered circumstances. People who lack flexibility are poor candidates for telescopic ambulation.

3. **Duration of Visual Impairment.** Congenitally visually impaired persons are often adept at adjusting to the inherent distortion of distance perception. Especially persons with 20/200 or less visual acuity.

4. **Degree of Visual Impairment** (without corrective systems). Generally speaking, persons who are not able to see visual detail at distance — 20/200 visual acuity or less in the better eye—are most willing to learn to use telescopic systems during ambulation.

Recommendations in the form of guidelines for the future were made by the group (Group 3) whose report appears above. They will be found under the heading “Recommendations from Group 3, Concerning Visual Training with Optical Aids: One Facet of Low Vision Services” on page 120.
**Bulletin of Prosthetics Research — Fall 1976**

**Attachment I (Manufacturers/Distributors)**

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<th>Codman &amp; Shurtleff, Inc.</th>
<th>NOIR</th>
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<td>Mentor Division</td>
<td>Recreational Innovations Co.</td>
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<td>Randolph, Mass. 02368</td>
<td>P.O. Box 203</td>
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<td>Saline, Michigan 48176</td>
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**Attachment II—Distance Optical Aids**

1. 2.5x Clip-on Telescope ................. Aloe, Selsi
2. 3.0x Emoskop .......................... Ocular Instruments Co.
3. 4.0x Huntscope ......................... Lighthouse
4. 6x-8x Monocular ....................... Lighthouse
5. 10x Monocular .......................... Lighthouse
6. 8x Zeiss Monocular .................... Lighthouse
7. 2.5x-3.5x Ring Telescope ............. Keller Optical, Hellinger
8. 6x-20x Large Monocular Prism Telescopes (1/2 binocular) .................. Lighthouse, Selsi
9. 2.5x-2.8x Sportocular (headborne binocular telescopes) ................ Lighthouse
10. 1.3x-4.5x Spectacle-mounted miniaturized telescopes .................. Lighthouse, Designs for Vision, Keeler Optical
11. Contact Lens Telescopes ............. Low Vision Consultant
12. Fresnel Prisms ....................... Local Optical Labs, Mentor Div.
13. Visors, Sunshades .................... Lighthouse, NOIR, Yorktown Optical
EVALUATION OF DISTANCE VISION WITH OPTICAL AIDS

Introduction

The background of research, development, clinical work, and training drawn upon in this section has, to a large extent, been derived from work with adult blind persons. Because this chapter concerns itself with evaluation problems and needs related to the adult low vision person, the reader should not infer that the evaluation approaches suggested are appropriate to low vision persons who are either quite young, aged, or multiply handicapped. While these groups all have much in common, it is nonetheless true that important differences exist, differences which merit attention in their own right. It is likely that evaluation strategies for these groups should be modified in scope and purpose even though much would apply.

Optical Aids and Mobility

Although there has been considerable interest shown in the mobility problems of the low vision blind during the past 5 years, it is still true that the prescription of optical aids for distance vision in general, and mobility in particular, lags well behind the prescription of such aids for reading and other close work. It is possible to explain this disparity in terms of demand, since a high proportion of the low vision population is elderly and sedentary. For this part of the population there may be less demand for successful mobility, whereas reading provides a means of communication and entertainment. However, the disparity goes much deeper than this. In some of the countries where mobility services are well developed, there still exists quite a serious lack of interaction between the clinician and the mobility practitioner.

In the case of the prescription of reading aids, the ophthalmologist or optometrist is able to make an assessment of the functional value of the optical aid with little difficulty; the task is straightforward and the level of functioning attained with the aid is reasonably easy to determine. Many of the distance aids, by their nature, are restricted in terms of field of view, magnification and cosmetic appearance. Size, weight, and the quality and efficiency of the systems are also limitations. Ophthalmologists and optometrists need to know more about the nature of the mobility task if they are to prescribe an optical aid for such purposes, and if that aid is to be effective in that context.

It would appear that there is a need for feedback from the training situation that would be helpful at the point of prescription and correction. The mobility specialist who has wide experience with the behaviors involved in mobility may be unable to carry out truly objective measures of change in mobility performance, although he can certainly make subjective assessments which have some practical validity. In the past,
there has been much frustration among the ranks of the orientation and mobility specialist profession because of a feeling that, given more detailed clinical information, appropriate mobility training programs for specific categories of the low vision blind could be developed. Thus the relationships between acuity level and walking speed when prism lenses are utilized, and the relationships between visual fields and mobility problems, may be helpful starting points for training. However, they do not automatically suggest whether training will lead to marked improvements in pedestrian movement; those mobility practitioners who have gained access to clinical data have been rather confused by the fact that typical field and acuity measures are not particularly good predictors of mobility performance, and have limitations in terms of the guidance they provide in the planning of training programs.

Because the traditional clinical measures have only a limited practical value to the mobility practitioner, it is evident that there is a need for an assessment procedure which relates to the performance of the individual rather than to his clinical condition alone. The traditional clinical measures are designed to preclude existing compensatory mechanisms on the part of the individual, and therefore measure the visual deficiency and not the ability to overcome the deficit.

It must be emphasized that clinical and performance assessments are not alternative methods of delineating the low vision condition. Each has its place in the process of selecting the most appropriate optical aid and monitoring the improvement which that aid mediates. Similarly, both the clinician and the instructor have information (or should develop information) that could be useful to the other in meeting the individual's needs. They should function as a team much more than they presently do. Moreover, this team concept should be expanded to include the low vision specialist and the psychologist, for both can contribute information helpful to the orientation and mobility specialist and can provide useful feedback to the ophthalmologist or optometrist regarding the individual's acceptance or rejection of the prescription.

Whereas we can confidently state that clinical measurement has reached quite a high level of sophistication, we are at present unable to identify an adequate procedure for the objective measurement of distance vision performance. The most obvious starting point for the development of such objective measures must be the specification of the distance vision tasks which we might expect the individual to perform. To measure the individual's success at reading from a blackboard is a very different matter from assessing success in moving freely around the environment. It is reasonably apparent that the disparity between clinical testing and the real-life task is greatest where dynamic situations are involved. Indeed, the various behaviors which constitute the mobility process require that the remaining vision be used in radically different
ways and that it must be augmented by other sensory modalities. Thus multiple, rather than single, measures are required.

The purpose of a functional evaluation is to provide data on the improvement in the performance of a specified skill or set of skills which is brought about when some special treatment (e.g., an aid or training procedure) is administered. In the context of low vision aids, evaluation provides the clinician with evidence of the magnitude of improvement which alternative treatments mediate and thus allows an appropriate selection or prescription to be made. Ideally, a knowledge of the individual's clinical condition should allow the prescription of an optical aid appropriate to specific applications; the success of this matching would then be evaluated on the basis of the individual's performance in the field.

Similarly, other members of the team can benefit from the feedback provided by the functional evaluation. The low vision specialist and orientation and mobility specialist may learn of the need for additional training procedures. For example, the low vision individual with a central scotoma may require eccentric fixation training in order adequately to utilize his vision to read street signs and/or locate and recognize traffic lights. Such information would then improve the ability of the low vision specialist to offer all necessary services to the low vision individual, as well as improve the application of orientation and mobility training for the individual. The research psychologist can also benefit from the feedback by gaining more information about individual and/or group performance, and be in a better position to develop modifications in low vision training procedures and/or develop alternative training procedures.

The Development of an Evaluation Procedure

If the traditional clinical assessment of distance vision is rejected on the grounds that it is unlikely to be an effective predictor of performance in real-life environments, then the problem becomes one of developing procedures where the disparities between clinical behaviors or tasks and the real-life ones are minimized. The dilemma now becomes obvious; on the one hand a purely clinical test in controlled conditions is very artificial and may not reflect practical situations; on the other hand, the range of tasks likely to be performed in real-life situations and the conditions in which they are carried out are so varied that a "representative" behavior or task is extremely difficult to define.

However, an examination of the arguments for and against the two approaches (using tasks which are artificial and tasks which are realistic) tends to favor an approach where performance in real-life environments is used. Indeed, the success of measuring the mobility performance of totally blind pedestrians in real environments that has already
been achieved must support this approach. This is not to rule out the use of artificial environments which can be demonstrated to relate to "real-life" situations. While not appearing to be a plausible avenue at this time, such environments may become a useful tool in the future. The advantages of assessment under artificial conditions include the ability to delineate the behavior precisely and, in the case of distance-vision assessment, the client can be required to perform a well defined set of operations wherein ambient light levels, target and background characteristics, etc., can be carefully controlled. While such assessments should be made, they need to be complemented with assessments of overall performance when controls are not present and situations vary widely.

It does not follow that real-life assessment should be based on random events, but that it should comprise meaningful sets of experiences which test the components of mobility performance.

For example, very few low vision pedestrians are likely to depend solely on their vision for mobility. As is true for totally blind pedestrians, information utilized in mobility is an integration of information derived from many sources and through different modalities. A recommended approach to evaluation in real-life environments requires that the pedestrian be observed walking for a comparatively long distance through sub-environments which represent a good selection of those conditions customarily encountered during normal mobility. By making the test route both protracted and varied, it should be possible to observe a performance which might be described as typical and representative. In effect, the control procedure is one of systematic variation of a number of behaviors and tasks rather than control of single environmental variables. Although the real-environment evaluation is susceptible to changing factors beyond the scope of systematic variations (e.g., weather, traffic and pedestrian density, the psychological state of the visually handicapped person, etc.), the effect of these factors over a number of retests is likely to be small for the totally blind but may have greater effect with low vision persons. These effects can be minimized by operationally defining the acceptable conditions for testing (e.g., morning hours, not raining etc.).

Existing Bases for Developing a Model Evaluation Procedure

While no present evaluation approach seems adequate for meeting the information needs of the team members (the clinician, the low vision specialist, the psychologist, and the orientation and mobility specialist) there are a number of ways that present experience can be constructively utilized in developing a new composite approach.

First, the practical tests employed to date by the Blind Mobility Research Unit, in England, over a 1300 meter route, represent a successful approach for the totally blind and may be adapted for low vision persons.
Second, a theoretical analysis of environmental sensing and preliminary evaluation instruments, presently under development by the American Institutes for Research, may prove useful for collecting objective data on specific behaviors when they occur during complex travel situations.

Third, the information derived from analysis of the causes of failure in field trials and from general comments about aids offered by trainees can be used to improve prescription.

These three approaches are thought to be complementary, and any ultimate evaluation model should probably incorporate aspects of each. They are described more fully in the next three sections of this paper.

Performance over Trial Routes

These specific measures of performance have been developed from an analysis of the intermediate goals of the mobility process. The intermediate goals are identified as the achievement of progress with minimum contact with potentially dangerous situations and the maximization of rate of progress within these constraints.

Intermediate Goal A: Maintenance of Personal Safety

The pedestrian wants to avoid physical contact with obstructions. A count of the total number of physical contacts with all observations, with a breakdown of the body areas where these contacts occur, will indicate the extent of body protection provided by the aid or aid combination. In the case of a low vision aid, this breakdown should suggest areas of travel space where visual information is inadequate.

The pedestrian intends to avoid accidental departures from the sidewalk at either the sidecurb or the downcurb. Consistent departures may again be indicative of inadequate visual information for the detection of the curb itself and for monitoring the distance from the inner shoreline.

The detection of moving vehicles and the estimation of speed of closure are critical factors in achieving safe road crossing. Generally, visually handicapped people make conservative estimations of distance and closing speed. Effective distance-vision aids should (with appropriate training) ensure both safe crossing and minimum curb waiting time. Conservatism is difficult to measure objectively, particularly when the evaluator has no control over the traffic situation. However, estimates based on the structured report of sighted observers appear to have acceptable validity for judging conservatism. An additional measure might include the degree of pedestrian veer during road crossing.

Intermediate Goal B: Maintenance of Efficient Progress

It is considered that a satisfactory rate of progress is not just a question of a high walking speed but is also based on smoothness of walking. The
pedestrian who walks at speeds which exceed the rate at which he can gather relevant environmental information (either visual or otherwise) has to accept frequent breaks in progress due to collisions. As more advance information is made available (for example, by appropriate distance vision aids) both walking speed and smoothness of walking, resulting from earlier path corrections, will increase. Smoothness of walking can be defined as the ratio between the total time taken to walk a specified distance and the actual time spent moving.

The pedestrian wishes to move between two places by the most direct route and to avoid wasteful movement from side to side on his line of travel. Any aid which provides information about the boundaries of the sidewalk should minimize such “weaving.” Currently available techniques for analysis of the moment-to-moment position of the pedestrian on the sidewalk could indicate the amount of reduction in linear variance achieved.

In order to maintain progress toward the desired destination, the pedestrian needs to be able to detect, locate and identify landmarks. If completion of the test route depends on using landmarks for decisions such as a change in direction, a person's deviation from the defined route will indicate failure in utilization of the aid. The low vision pedestrian has considerable potential for identifying landmarks, given the provision of an appropriate aid and appropriate instruction in search strategies.

Intermediate Goal C: Maintaining Acceptable Levels of Psychological Stress

The mobility process is known to be accompanied by varying levels of psychological stress, depending on the complexity of the environment through which the pedestrian is traveling. It could well be that a progressive increase in the amount of environmental information leading to more effective mobility would be accompanied by a reduction in measured stress. Such a measure could well be a good indicator of the appropriateness of the information (either visual or otherwise) which was being provided.

Heart rate has been found to be too complex as a measure of local psychological stress. However, relative stride length does seem to be a reasonably valid measure and it correlates highly with subjective stress ratings.

One serious methodological problem which arises in assessments in the real environment is that of the equivalence of test and retest conditions. In order to achieve equivalence it becomes necessary to use the same route in both cases. Care must be taken to ensure that improvements observed on retest are due to the aid and not to familiarization with the route. However, for the totally blind it has been established that for protracted and varied routes, little improvement in performance
takes place even after five or six passes of the same route. The extent to which this would apply to low vision persons needs to be established.

Assessment of Skills through Criterion Exercises

It is clear that the evaluation should yield firm evidence as to what skills have been attained that will transfer to other situations. Nothing is worse than to go through an extensive training program only to find that the visually impaired person remains ineffective in his performance when he leaves the training station.

It is also clear that individual differences exist regarding the trainee’s present capabilities and what he can most benefit from in terms of training. Therefore, information needs to be obtained at the outset of training to determine where the instructional emphasis should be placed, and at the end of training to learn whether the objectives of the trainer and the visually impaired person have been met satisfactorily or whether further training is appropriate. An evaluation approach which incorporates a variety of discrete exercises would allow for early identification of the trainee’s unique needs and the appropriate design of training so as to enhance trainee-trainer interaction.

Further, if evaluative data are to be collected uniformly at different training sites, and merged for programmatic evaluation purposes, it is crucial that the criterion exercises be reasonably standard. This suggests that the conditions of testing and the language to be used by the field evaluator (or orientation and mobility specialist) should be described in sufficient detail that replication can be consistent across different locations with different field evaluators.

We suggest that more important skill areas should include the following:

A. The development of a cognitive map (e.g., physical orientation, directional orientation, relation of environmental elements to each other and to the traveler, and route planning).

B. The reaching of a destination (e.g., following linear and non-linear paths, interacting with others along the travel route, correcting errors, and the use of transportation).

C. The increase in sensory and perceptual sophistication (e.g., making relevant decisions, increased sensory functioning, and increased knowledge of the environment).

D. The improvement of personal factors (e.g., improving learning skills, increased motivation to travel, and better self-understanding).

The evaluation protocol now being developed by the American Institutes for Research will include consideration of these skill areas. It should be recognized, however, that the initial criterion exercises that are being developed are essentially a priori in nature. They will need
validation and/or modification in the light of experience gained when pilot tryouts of the protocol have been completed. Similarly, the criterion exercises have been deliberately kept at a simple level, facilitating their being scored in the field. (It should be remembered that the orientation and mobility specialist's attention will probably be divided between scoring and observation and the time devoted to scoring should be minimized.) Thus, it may well be that future experience will suggest certain skill areas in which the criterion exercises need to be expanded in number or modified in form in order to reflect more fully (and accurately) the level of skill that has been reached.

Within these limitations, which derive from its present formative stage, the skills criterion exercise approach offers considerable promise for introducing much needed standards and allowing inter-device comparisons on a broader basis than has been possible to date.

Behavioral Assessment of Visual Skills

Initial indications of the information that can be used in improving prescriptions and training may be derived from an analysis of the causes of failure in field trials, as well as through the general comments of team members and the low vision individual concerning the field trial. On the basis of the preceding discussion, the following data points appear relevant:

1. The overall performance of the low vision individual.
2. Perceptual problems induced by the optical aid (e.g., aberration).
3. Determination of the optimal light levels in which the low vision individual functions at maximal efficiency (e.g., overcast days).
4. The low vision individual's proficiency in the use of the aid (e.g., focusing).
5. The low vision individual's proficiency in acquiring information (e.g., spotting landmarks).
6. The low vision individual's subjective response to the aid (e.g., good or bad).
7. The low vision individual's reactions to aspects of a unique aid (e.g., prisms).
8. The low vision individual's ability to pursue targets using movements of eyes, head and body.
9. The low vision individual's adaptation to changing environmental conditions and/or changes in the condition of the visual aid.
10. The low vision individual's recognition of form.
11. The low vision individual's perception of space and direction.
12. The low vision individual's ability to monitor body movement visually.
13. The low vision individual's rapidity of processing visual information from geographically separate sources.
14. The low vision individual's ability to conceptualize the environment accurately.
15. The low vision individual's ability to evaluate environmental color cues.

The above list is not intended to be an exhaustive list, but rather an indication of the variety of data points a visual skills evaluation can and should provide.

Summary

There is a need to increase the flow of evaluative information among the clinical practitioner, the low vision specialist, the orientation and mobility specialist, and the psychologist. These persons constitute an evaluative team serving the needs of the low vision individual. Each of them is dependent in some way upon the information that can be fed back to correct and improve prescription and training procedures.

There is a need to develop evaluation of three sorts. These include: 1. the use of repeated field trials over extended routes to assess overall performance with and without aids; 2. the use of specific, standard criterion exercises to sample the skills and behaviors that presumably enable the low vision person to operate effectively even though conditions and situations may vary widely; and 3. the use of assessment procedures that are especially tailored to the information needs of the optometrist or ophthalmologist, yielding data on performance specifically attributable to visual functioning.

It is evident that much more work must be done at the research and development level before such a balanced evaluation approach can be routinely used in practice. Adequate lead time must be allowed for validation studies, for needed modifications in the evaluation procedures, and for the amassing of numbers of cases using different aids, before we are in a position to draw conclusions about the value of these procedures. Nevertheless, we are optimistic that they will prove to be useful to all concerned.

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8 Recommendations in the form of guidelines for the future were made by the group (Group 4) whose report appears above. They will be found under the heading “Recommendations from Group 4, Concerning a Functional Evaluation of Distance Vision with Optical Aids” on page 122.
THE LOW VISION PERSON — "A MARGINAL MAN"

Part 1 — Psychosocial Aspects of Low Vision

Introduction

One segment of the visually impaired population is composed of a group of persons who fall into the nebulous classification of "low vision" or "partially sighted."

The multidisciplinary approach to rehabilitation and service delivery has been utilized successfully for many years. However, there is a serious "professional lag" in rehabilitation programs for the low vision person. Services for this group are severely segmented. This is due in part, to the fact that the majority of educational and training programs are geared toward the totally blind or the totally sighted. Useful theoretical concepts and information regarding low vision are minimal. Additionally, eligibility for rehabilitation programs, monetary benefits, and other services is sometimes difficult to establish.

Working with the low vision person mandates an individualized approach. The person who has newly acquired sight loss may be fearful and uncertain as to how he is going to cope with the new handicap. The individual who has had long-term visual difficulties may also be fearful and uncertain. In addition, he may be frustrated because his methods of dealing with problems are insufficient and inappropriate for him to lead a satisfying and productive life.

A cooperative effort on the part of professionals recognizing the need to individualize the approach, combined with an attempt to decrease the segmentation, could prove very productive in terms of successful personal adjustment.

This chapter will identify many of the problems encountered by the low vision person as he relates to others, and will attempt to provide some guidelines for the rehabilitation specialist working with him.

Definition

Mehr and Freid offer this definition of low vision: "Low vision, partial sight or subnormal vision may be defined as reduced central acuity or visual field loss which, even with the best optical correction provided by regular lenses, still results in visual impairment from a performance standpoint" (Mehr & Freid, p. 1). Mehr and Freid elaborate on their definition to say that although the definition does not contain numerical acuities, their definition would include persons whose vision ranges from 20/70 in the better eye with corrective lenses at the upper level, to any form vision at the lower level. There is an excellent chance for optical help at 20/600 acuity, but many are helped with even less measurable acuity.
A person may also be categorized as low vision if he has relatively severe peripheral field constrictions, despite normal visual acuity.

**General Comments**

1. A large majority of the normally sighted population tends to think of vision in terms of *total sight* or *total loss of sight.*

2. The way a low vision person thinks or feels about himself or his situation, as it relates to his visual loss, usually reflects the attitudes of his close associates regarding visual difficulties.

3. For some persons during the initial stages of adjustment to sight loss, where there is usable remaining vision, the nearer training and equipment come to being defined specifically for the BLIND, the more resistive the person will be to participate in or utilize these types of equipment. This is particularly true for the cane and braille. (On rare occasions, some persons may tend to identify with blindness beyond what would be required by the actual loss.) Special expertise is needed to move a low vision person through all phases of adjustment. Specialists are generally aware that it is very difficult to train or educate a person for eventual *total* sight loss. It is equally difficult to educate the general public regarding *low* vision.

4. Improper refraction or prescription of lenses can result in a pseudo-low vision, or may complicate actual visual deficiencies. Bent or poorly fitted frames can also create unnecessary visual problems.

5. Vast numbers of special eyeglasses and visual aids are lying idle because they are considered to be aesthetically unacceptable by the intended users. This opinion of often shared by family and close associates. Glasses and aids may also be filed in the dresser drawer simply because the intended user has never been trained in their effective use. This is particularly true for the aged and multiply handicapped — palsied hands and head frequently prevent optimum benefits from hand-held visual aids. During follow-up efforts the specialist should try to determine whether the aids are not being used as a result of psychological problems.

**Common Characteristics of Low Vision**

Each eye condition has its own range of characteristics that vary from person to person and/or from time to time or as to whether they are congenital or acquired gradually or suddenly. More often than not, the low vision person may have difficulty defining what he may or may not be able to see one hour, one day, or one week in the future due to the uniqueness of his visual problems.

Changing light conditions may also lead to minute-to-minute variations.

Eye conditions that are commonly associated with low vision are:
traumatic injury to the eye, diabetic retinopathy (most frequent cause of visual loss), cataracts, glaucoma, macular degeneration, retinitis pigmentosa, amblyopia, nystagmus, and degenerative diseases often labeled "optic atrophy."

Some examples of the characteristics of low vision are as follows:
1. Changes in lighting often cause considerable variations in vision for the low vision person.
2. Low vision can sometimes be related to the inability of the eye to focus properly.
3. Vision may vary in accord with general health and/or emotional state and changes in the environment.
4. Certain eye conditions, scratched or soiled lenses, or lenses that are no longer providing maximum vision due to changes in the eye condition, can elicit unusual mannerisms. Examples are: excessive squinting or blinking, profuse turning of the head, falling over objects, excessive preoccupation with the disability, and misinterpretation of the environment or of other people.
5. The person with a severe peripheral field loss (tunnel vision) may be able to see parts of objects or written words fairly well if his visual acuity is at a relatively normal level; however, when the peripheral field loss is combined with severe loss of visual acuity, objects and written materials may be severely distorted and unrecognizable.
6. The person with loss of central vision, but adequate peripheral vision, may not be able to read written materials but may get around quite well without stumbling or bumping into objects.
7. Persons with fluctuating visual acuity may not catch the smiles of friends or the grease spot on his own clothing at any given time, but one hour later, or the next day, they may notice these quite easily.
8. A vast majority of persons who have low vision suffer from photophobia (light sensitivity). This can create irritability and exhaustion without the person being able to identify the reasons. Light coming from above, below, or from the sides can be as annoying as direct light into the eyes. Elderly persons (particularly those with cataracts) frequently suffer light sensitivity.
9. In many cases, low vision is accompanied by varying degrees of loss of depth perception and/or color discrimination. The height of curbs, size of objects and the speed of oncoming traffic frequently present problems. For example, a person may be able to ascend stairs very well due to the shadow the vertical portion of the step provides; however, descending the stairs may present a problem since the steps, looking from top to bottom, may appear as a flat plane, due to the lack of contrast.

Contrast becomes even more important when dealing with colors.
Walls, doorjambs and doors all painted the same color make it extremely difficult for the low vision person to locate the entrance or notice a partially open door. A dark car moving on the street where there is green foliage may not be as discernible as the same car moving in a light colored background such as provided by a concrete building, a white picket fence, or the open sky.

Some persons may see better in bright sunlight, while others may see better in dim light. Some persons may be nearly totally blind at night, except for light projection, but are able to read the finest print with certain types of lighting. It seems that no two low vision persons have identical losses or variations in vision at any given time, with any given candlepower of light, or the same prescription of lenses.

10. The low vision person may be using much more energy than the normally sighted person in conducting the routines of daily living. It is generally accepted that a considerable amount of energy output of a normally sighted person is utilized in assimilating visual information. Consequently, a seemingly indifferent, uncooperative or negative attitude may be actually related to extreme fatigue combine with a variety of anxiety producing factors.

11. At times it may seem that loss of vision has been accompanied by partial loss of memory or loss of the ability to reason in the abstract. In the absence of brain damage or other physical causes, the inability to remember or to reason logically may be explained by several other factors. During the initial phases of sight loss, there is frequently preoccupation with the multiplicity of problems presented by the visual deficiency. More than totally sighted persons realize, the visual cues received and utilized each day make up a large portion of retention and reasoning capacity. The low vision person may have gaps in experience and information as he has “passed” as sighted. Some basic reading and spelling skills may be very poor.

When there are family problems which characteristically accompany loss of sight by a family member, the switching from family problems to the problems of coping with the environment and on to the task of assimilating general information, counseling or training, may elicit statements and responses that could be interpreted as signs of memory loss or loss of ability to reason.

Most of these behaviors are normal reactions to distorted visual information and may lead to frustrations that cause extreme irritability, fatigue, loss in judgment and frequently an uncooperative or nonresponsive attitude.

These are the major factors that mandate an individualized approach to working with low vision persons. They are also the factors that frequently lead to confusion, indecisiveness and frustration for the family, friends, employers and many professionals.
Personal Adjustment Problems

There are, basically, two major areas of concern for the low vision person. One involves unfamiliar places and situations; the other involves meeting and associating with other persons. The low vision person may have the tendency to think and behave only in terms of his current situation, with little consideration given to realistic, long-term goals for him and his family. Much too often, planning for the future has been thwarted by a variety of circumstances that are relatively vague, volatile, and unpredictable.

Others may dwell on the future, anticipating how things will some day be as they were before, attaching little or no significance to the need for developing technical or social skills that would allow them to function more independently and productively.

Most every low vision person will experience some realistic concerns that, by their general nature, are difficult to deal with or resolve. For example, there may be the uncertainty as to whether or not his vision will remain stable, decrease or improve. It may be the reactions of others to his visual impairment or his concern for his family life and future productivity. Maccoby, Newcomb and Hartley state: “The employee’s decision to quit the job is rarely made exclusively on the basis of a momentary frustration or an undesirable present situation; she usually quits when she also sees the future as equally hopeless” (Maccoby, Newcomb & Hartley; p. 249).

It is also difficult for him to imagine that others, sighted or unsighted, professional or nonprofessional, could understand the complexity and frustrations of his personal situation, when even he, knowing the myriad of details, has been unable to resolve many of the simplest problems. Consequently, during the initial participation in a program of rehabilitation, he may resist involvement in unfamiliar or frustrating situations. As a rule, too many friends and associates have already given advice that has led to naught or has complicated existing problems.

If the low vision person has the inclination to act as though he can see more or less than he theoretically should see, there are probably legitimate reasons for doing so. These actions and responses may have served a useful purpose for him as methods of coping with the unpredictable. These reasons may be as much unknown to him as to his associates.

The personality structure of the low vision person may determine his reactions to any given situation. If he is basically dependent, the dependency patterns may be exaggerated. On the other hand, a person with an independent personality may magnify these characteristics to the point of unrealistic aspirations and unsafe performance. Some individuals who are basically dependent or unsure of themselves may present a facade of independence by verbally attributing special skills to themselves, or by “over-developing” insignificant skills. Neither of these are
legitimate measures of independence. An individual may be ashamed of his poor vision and/or his unattractive glasses or visual aids and attempt to hide them by isolating himself or by assuming the guise of “studious homebody.” Habitually playing the part of the “clown” or the “cynic” may be attempts at compensating for, or diverting attention from, his visual shortcomings.

Many adjustment patterns may also be attempts to maintain or regain a previously held status or, at least, be acknowledged as a person with some type of status, preferably a desirable one. Lazarus states:

Some people are believed to utilize the defense of repression in coping with threat, (in this case “THREAT” is fear of loss of vision) while others employ isolation as their preferred mode of defense. The repressor is said to show this tendency in styles of thinking such as pollyannishness, naivete, and labile emotional expression . . . . The isolator, in contrast, is apt to take an intellectualized approach to things, display detachment, qualify extensively, and often show ostentatious use of big words and technical terms where simpler ones would do . . . . The relationship sketched here provides prime instances of the general importance of the society and its culture in shaping adjustment patterns . . . . Stratification involves barriers to free interaction of people, barriers based on status (Lazarus, R.S., 1969).

Usually, the longer the low vision person is left to his own devices in developing methods of coping with frustrating situations, the more extensive will be his adjustment problems.

There has been a continuing interest in psychology since the first suggestion, by C. G. Jung, of the polarization of individuals into an introversion-extroversion dichotomy. In recent studies (Young, F.A., R.A. Singer, and D. Foster; 1975) the researchers have found a high correlation between visual characteristics of refractive errors and these personality characteristics of introversion-extroversion. As a matter of fact, it seems possible to identify whether or not an individual has a myopic or non-myopic refractive characteristic simply by using psychological test scores.

One of the primary characteristics of the introverted personality is that the individual has spent a good deal of time and effort attempting to understand himself, his own motivations, attitudes, desires, inadequacies, adequacies, etc. It is our belief that such an individual could handle the affliction of partial sightedness without a great deal of difficulty and could develop the techniques for navigation and interpersonal relationship which would enable him to function reasonably well in his physical and social environments.

On the other hand, those individuals who tend to be extroverted
usually do not pass through this self-examination phase and frequently have little or no awareness of their own personal characteristics but rather depend upon other individuals and contact with other individuals to help them move through their life space. Such an individual is likely to be greatly disturbed when he is afflicted with the visual condition which results in partial sight, since he has not developed a sufficient awareness of his own characteristics to be able to stand this additional stress.

If it is correct to assume that the introverted person will be able to stand the strain and stress of low vision more effectively than the extroverted person, this suggests the need to determine the basic personality characteristics of our patients to help us provide them with the proper type of reeducation to handle their particular problems. Furthermore, it appears to indicate that the extroverted person will require a considerable amount of assistance in helping him to adapt to this new condition.

Social Adjustment Problems

Mehr, Mehr, and Ault (1970) contend that “the partially sighted person is one who often finds himself in a state of ‘Limbo,’ bound by the traditional mandates of responsibility and productivity.”

Recorded case studies verify that it is very difficult for the low vision person to obtain or hold respectable employment on the competitive labor market. Perhaps he cannot, or should not, drive a car. His or her position as head of household or homemaker is jeopardized. Frequently, he must put aside some of his civic duties. Most devastating is to be categorized as a worthy charity case who has little or nothing to contribute on behalf of his family or community. “Blindness is a social role that people who have serious difficulty seeing, or who cannot see at all, must learn to play” (Scott, 1969).

The low vision child feels the effects of attitudes, role expectations and stigmas that are passed from one generation to the other. Children, teachers and other adults are sometimes prone to ridicule the mannerisms of the low vision child and it is not too long before the child thinks of himself in the same way. His role and label have been attached and frequently guide him in future behaviors and associations if he does not receive some very sophisticated guidance.

A common reaction of lay persons as well as many professionals to initial contact with persons who have reduced vision is to respond along a continuum that ranges from “pity,” “overindulgence” and “over-protection” at one end to “doubts,” “denial” and “rejection” at the other end. Polarized reactions are probably a manifestation of bewilderment, combined with hasty interpretations of the person’s mannerisms and an uncertainty as to the appropriate response in the situation.

People frequently base their impressions, and subsequently their be-
behavior, on personal interpretations of situations or the activities and verbalizations of other persons. These interpretations, more often than not, guide a person in the number and intensity of future contacts with these situations or persons. If one finds his interpretations are incorrect, a variety of responses may occur. He may feel he has been deceived; he may become embarrassed or think he has said or done something to offend the low vision person; he may be inquisitive and ask many questions; or he may avoid talking with the person altogether.

The manner in which the low vision person responds to the reactions of others will determine the degree to which he will be accepted by an individual or group of individuals. He may frequently be informally tested by normally sighted persons, as well as by the totally blind, with little or no useful feedback on the outcome of the testing (this testing is usually done to determine whether or not the person actually sees what he says he sees, whether he identifies with the totally blind population or the sighted public, etc.). The testing usually only adds to the confusion of the tester, and frequently strengthens preconceptions. What many fail to understand is that, unlike the totally blind person who must use senses other than sight to deal with his visual loss, the low vision person usually finds it necessary and frequently productive to combine the uses of his remaining sight with other senses. The multitude of variations in situations and in his own vision mandates a high level of flexibility and adaptability in coping with the environment and other persons: unless, of course, he decides to train himself to see, react and behave on the same level at all times — which will probably be his lowest level of functioning.

The problems associated with variations in situations and vision may seem insignificant or trivial to the normally sighted person but are frequently embarrassing, frustrating, sometimes confusing and often anger-producing for the low vision person.

The low vision person feels he must learn a much wider variety of responses to social situations than the ordinary person. However, his reservoir of behaviors and responses is the very thing that presents him with the most problems.

The low vision person would like to be included in some grouping. He needs and seeks an identity. He learns to behave and respond in accord with the expectations of others. If they expect him to act blind, he may try to act blind; if they expect him to act sighted, he may try to act sighted. People then think they know how to treat him and he thinks he knows how to behave. Newcomb, Turner, and Converse (1965, p. 320) state:

We have tried to show that interpersonal attraction does not “just happen”; it follows lawful regularities according to which particular individuals in specific situations are rewarded by particular
other persons...a good fit between getting and giving rewards is more likely to be found under certain conditions than under others. A really good fit presupposes a continued period of interaction, so that persons can try each other out and discover that they are both giving and receiving rewards; group structuring is a trying-out process. Structural forms depend, on the one hand, on the disbursement of members' attitudes and personal characteristics and the way these are combined in the same person; on the other hand, they also depend on situational conditions. Situational conditions determine the opportunities that members will have to try each other out, as well as the nature of their rewards.

The contents of Part 1 are devoted to helping the rehabilitation specialist better understand a few of the problems associated with low vision. While many of these problems obviously are characteristic of people in general, for low vision people personal and social adjustment problems may be exaggerated or magnified.

It should also be remembered that some of the problems may vary for low vision persons with congenital impairments as opposed to adventitious impairments.

Part 2 is devoted to aiding the rehabilitation specialist in developing his professional expertise in working with the low vision person.

**Part 2—The Role of the Rehabilitation Specialist—Emphasize the Positive**

The rehabilitation specialist is defined as any professional working with low vision persons. According to Reverend Thomas J. Carroll (1961, p. 313):

To work effectively with the partially sighted, it must be understood that people suffering from this handicap not only see less than normally sighted people, but in many cases their sight is distorted, making shapes grotesque, forms misshapen and colors weakened or blurred. The partially sighted person is handicapped and severely so. The handicap is not blindness; it is partial sightedness.

The specialist needs to be knowledgeable in the many ways low vision is manifest. He needs to know the functional limitations of diseased or injured eyes, and he should be aware of how the low vision person perceives his condition. If necessary, he should facilitate the person’s achievement of a realistic assessment of that condition. There should be awareness of the person’s overall physical and mental capabilities and potential. Knowledge of the person’s interests and aspirations is of
prime importance. Reality factors involving plans for the future must be given consideration. Family structure and lifestyle must be evaluated.

Probably as important as any aspect of low vision is to know the wide range of visual aids, the new aids being developed, their utilitarian potential and limitations, and especially the client's willingness to use these aids. The specialist must be ready at any time to deal with the hopes and disappointments that may accompany the introduction of visual aids into his client's life. He should utilize every available resource to overcome negative factors. The rehabilitation specialist must also be able to evaluate whether the client is using his vision to its fullest potential. Combining this knowledge into highly individualized training and counseling sessions may lead to a seemingly well-adjusted, capable person. In addition to this training, it is imperative that the family and close associates of the low vision person be given guidance in understanding the person's level of functioning to help him transition back to his home environment.

There must be an understanding of the environmental, psychological and social factors that influence adjustment patterns. These three factors are interrelated; hence, problems in one area will be compounded when combined with problems in one or both of the other areas. These problems are manifested through fears, doubts, embarrassments, misperceptions and, at times, a pseudo-desire to be identified as totally blind, if he cannot be totally sighted.

Few people have the innate ability to understand and work effectively with persons who have sight loss. The mechanism of conscious control is important both from the standpoint of helping the low vision trainee in developing or redeveloping his adaptive processes, as well as the need for constant monitoring of our own prejudices and anxieties as we work professionally in the rehabilitation process. The professional worker has his own set of defense mechanisms coming from his early environment. Under certain circumstances they may hinder the rehabilitation process as much as help it.

The disability of low vision creates a somewhat different set of circumstances than the disability of total blindness. It must be kept in mind, however, that every person is an individual with his own individual adaptive processes and we can be of much more service by strictly avoiding making him a stereotyped individual with a visual handicap. At the same time, the system of adaptive processes is similar from one individual to the next.

Although there will always be individual differences in how each person reacts to irreversible sight loss, there are some characteristic patterns (Veterans Admin., 1974).

1. The initial reaction of an individual to severe visual impairment is usually disbelief that this has happened or is happening to
him. He may seem bewildered or confused.
2. Even after the person realizes that the sight loss is actual and irreversible, he may resist the idea that he must learn to function in new ways with this handicapping condition. He may refuse or ignore aid or counseling.
3. Frequently he will go through a period of “shopping” throughout the medical profession in search of answers he wishes to hear—usually, that normal sight can be restored.
4. After exhausting the medical resources, and frequently his finances, he may withdraw to a state of inactivity and dependence, or he may randomly search for something meaningful that will allow him to maintain or regain his former status as a productive person.

Professional intervention at any one of these stages requires a special expertise that combines training in skills and concerned guidance.

Training in skills should not be limited to proper use of visual aids, mobility, written communications, manual skills, activities of daily living and vocational or educational planning; it should also include many sociopsychological factors, one of which is helping low vision persons establish and maintain satisfying and meaningful interpersonal relationships. In any ongoing relationship there must be reciprocal actions that provide the second or third person with a certain type of inner satisfaction. The rehabilitation specialist can support this learning by providing encouragement and direction during the process.

During the initial phases of a guided adjustment, the low vision person should have the opportunity to make and correct mistakes in a variety of situations. Successful experiences foster anticipation of, and a desire for, similar experiences in the future. Concentration on the positive aspects of the person's capabilities and personality seems to be a factor in continuing successful adjustment; that is, emphasis on those things he can or will be able to do, rather than those things he cannot or will not be able to do. This is with the understanding of the low vision person that he does have some realistic limitations.

To question him frequently regarding his vision during the initial stages of adjustment may lead to resistance or rejection of the total plan. If his income depends on his status of legal blindness, he may become suspicious of the questioning, regarding it as an attempt to render him “not in the category of legal blindness.” Extensive questioning may reinforce denial of the impairment if the person is using that defense mechanism.

If he seems more capable as he becomes familiar with places and situations, further development along these lines should be encouraged, rather than questioning his vision. If he can see better at some times than
at others, he should be informed that this is understood and that many low vision persons experience fluctuations in their vision.

He must be aware and understand that low vision cannot be the major criterion for other persons determining whether they will or will not like him. Not every person will wish to be friends — even though the low vision person may feel this is necessary to insure availability of their assistance at one time or another. Satisfying and lasting friendships are, more often than not, based on such things as mutual respect and interests, psychological make-up, aspiration levels, and other more definable factors such as religious affiliations, age, parenthood, political and professional ties and a general agreement that the other person is not a friend because he can be “used” at some time or another. When he is able to define, to the satisfaction of other persons, if necessary, the general nature and limitations of his visual condition, he can then move on into discussion of mutual interests not necessarily related to his handicap. At this point relationships should become more meaningful to him and to his associates.

**Guidelines for the Low Vision Person**

Several specialists have requested some guidelines on how a low vision person goes about defining to others the general nature and limitations of his visual deficiency. Again, this must be individualized to situation, the overt and covert reasons for individuals initiating interactions with the low vision person, and the type of communication or behavior by the low vision person that prompted the interaction. However, there are some general guidelines that may be useful and relevant in specific situations.

1. Try not to act annoyed or become defensive about inquiries or statements regarding one’s sight or behavior, regardless of any negative connotations, implicit or explicit.

2. Consider any interaction as an opportunity to make a friend or, at least, help others to understand the general nature of one’s own as well as the sight loss of others (remember — small “doses” unless the other person persists).

3. Occasionally, a bit of humor, if appropriate, interjected into the situation, can alleviate some of the doubts, concerns and misperceptions, and frequently prevent avoidance or rejection in the future. However, the humor must be presented in a manner that is socially acceptable and does not place the low vision person in the position of the “typical clown” or cause him to become the brunt of all joking.

4. During the initial contact with total strangers, try to avoid discussions tempered with biases and bigotry. If one desires a debate, he can initiate this after he knows the person better. This is not to imply that one should sacrifice principles — use common sense and diplomacy.
5. Don't expect the other person to initiate all the "pleasantries" and subjects for discussion. Show that you are as interested in him and his interests as he is in yours. Give compliments when compliments are due, but stay away from over-solicitousness.

6. Be as enthusiastic about life as possible and DON'T complain about your unfortunate handicap, family situation or other matters that would tend to alienate other persons. Usually they have problems of their own without adding those of others. If the discussion of one's sight lingers on, attempt to find some positive aspects of it and discuss these rather than the negative.

Guidelines for Working with Families

The rehabilitation process should involve as many family members and close associates as possible. There seem to be three prime factors that lead to successful individual and family adjustment.

1. Unwarranted but understandable fears, doubts, embarrassments, false perceptions and negative attitudes are diminished (not changed) by having the family and close associates go through a sequence of systematic observations and guided discussions; i.e., observing the low vision person function in a variety of situations and under a variety of lighting conditions, etc., and then discussing the various aspects that have presented or are presenting problems.

2. Positive attitudes and appropriate methods for dealing with problems are acquired via didactic participation in the rehabilitation program and qualified professional counseling.

3. Realistic planning for the future is developed (although very slowly) through the combined knowledge and efforts of the low vision person, his family, and a knowledgeable, multidisciplinary team which provides meaningful follow-up. One major function of the team is to educate and encourage the total family to handle problems by utilizing their own ingenuity and the resources available to them in their home community.

On rare occasions, it has been found that low vision individuals may claim less vision than they are theoretically supposed to have or that their behavior supports. In these instances, consideration should be given to aiding the person with this dilemma. Prior to any discussion with the person, the following factors need thorough evaluation:

1. The specialist should be aware of his own attitudes and feelings regarding blindness or severe visual impairment. It is quite natural for a "normally" sighted person who has had little or no contact with visual impairment to feel uneasy regarding what should be said or done. If the low vision person is sensitive about his sight loss, the specialist may need to concentrate on fostering and maintaining a meaningful relationship
rather than pursuing discussions regarding the visual loss.

2. There are times, on initial contact, when the specialist feels that there is little that can be done to help persons who have visual loss. On exploration, one usually finds the person has many undeveloped capabilities and positive characteristics which can be used to overcome the effects of the handicapping condition. Follow through is very important and may involve several contacts before motivation is engendered.

3. The expectations that the rehabilitation specialist has for his client need constant evaluation and frequent revision. For example, a person with rapidly deteriorating vision may need different training, counseling, changes in visual aids, equipment, and feedback from the specialist. The specialist must comprehend the functional aspects of special lenses (glasses) and other visual aids and be cognizant of their practicality and limitations. He must be able to evaluate when any given individual needs to combine visual aids with aids designed specifically for the totally blind and convey this to the person in a manner acceptable to the client.

4. More often than not, the low vision person will reveal or discuss his lowest level of vision rather than his highest or peak levels of vision. This usually keeps him on firm grounds that are less disputable than discussing his highest level. If he discusses or behaves on the highest level, he feels the expectation is that he will operate on this level at all times.

5. To make progress and acquire desired results in discussing variations in vision, or what a person can or cannot see, requires a delicate balance in timing and the appropriate approach for each individual. Frequently, improper timing or an inappropriate approach can do more harm than good. If correctly handled, however, a confrontation can save the low vision person months and sometimes years of frustration over attempts to feign excessive loss of vision. These deceptive actions usually stem from fear of losing monetary benefits, not receiving aid when one needs it, or fear of being rejected by individuals or a group with which he wishes to be associated. Progress will probably be slow and a certain amount of regression may be anticipated. In the process, the low vision person must acquire something more meaningful to him than any secondary gains he may receive by understating or underutilization of his actual visual capabilities; otherwise, an almost immutable dependency pattern may be established.

The other extreme is for the low vision person to be very fearful of becoming overly dependent on others. He relishes and thrives on his (actual or desired) independence. He may try to act as though he sees more than he actually is able to see, which is usually related to the fear of losing status, friendships and employment. Prevarication in this direction can be physically hazardous, as well as devastating to interpersonal relationships.
6. Regardless of the time or circumstances, hasty accusations of “intent to deceive” based on superficial evidence may be more destructive to the rehabilitation process than the frustrations of the client’s own trial and error adaptations and learning.

For many low vision individuals the rehabilitation process includes the preparation for and placement in work situations. To the extent that this occupational placement results in meaningful employment providing for social achievement and recognition, the adjustment process will be more satisfactory.

Recent federal, state, and local rehabilitation legislation is serving to increase employment opportunities for low vision persons. With these increased opportunities, more attention needs to be placed on the identification of occupational activities of a meaningful nature which can be accomplished in a safe and satisfying environment by low vision individuals.

**Conclusion**

The almost universal desire to aid the totally blind does not usually apply to aiding low vision persons. To work with a person with reduced vision is usually more frustrating and less rewarding than working with the totally blind, since the end result is less evident. The technical skills needed to work with the totally blind are quite exacting and clear-cut. Comparable techniques for working with the low vision person are not as well defined. Working with the low vision person requires added tenacity and flexibility, coupled with a strong inclination toward innovation and deviation from the patterned methods. The field is open. The subjects are many. The challenge will probably be met by those who realize that versatility and pioneering must be an integral part of their professional expertise.

There must be a combined professional effort to provide a range of services with a continuity that will bring the low vision person into a comfortable, satisfying and productive way of life — the low vision person should be made aware that his visual defect does not make him any less a man or woman. On the contrary, the ability to accept and deal realistically with the problem may indicate inner strengths in character.

The rehabilitation process should include knowledgeable and concerned professional guidance, combined with a planned, but variable, sequence of graduated accomplishments that reflect the abilities and realistic aspirations of the client.

One major objective of the specialist while working with the low vision client is to prevent him from being “caught in the middle” or “hanging in the fringes” as a marginal person, neither “blind” nor “sighted.” The ultimate goal is for low vision persons to realize and accept that they have
the major responsibility for shaping their own destiny. h

h Recommendations in the form of guidelines for the future were made by the group (Group 5) whose report appears above. They will be found under the heading "The Low Vision Person—'A Marginal Man'" on page—123.
SUMMARY OF CONFERENCE RECOMMENDATIONS

Introduction

During the Workshop on Low Vision Mobility, each of the five groups was asked to make recommendations concerning their area of specialization. These recommendations were to be in the form of guidelines for the future and were to be based upon the best available information at the time of the Workshop.

Recommendations from Group 1
(Concerning the Evaluation of Visual Function)

I. Research Procedures and Guidelines. — It is recommended that an interdisciplinary group be formed under the auspices of the National Research Council, National Eye Institute, or other interested organizations, to meet for the purpose of establishing research procedures and guidelines for the evaluation of function in the visually impaired. In this respect, it is recommended that this group address itself to two general areas of concern.

A. A more extensive and accurate evaluation of the capacities of the visually impaired individual in regard to existing standard visual tests. Such a systematic research program is necessary in order to satisfy:

1. The need to establish a primary statistical basis from which to compare the efficiency of various behaviors and direct further research efforts.
2. The need to establish guidelines and standards for the evaluation of functioning in the visually impaired.
3. The need to develop a basis for revising and upgrading evaluation methods in order to establish more relevant and applicable preliminary testing procedures.

B. It is equally important to develop an assessment program to evaluate the efficiency of the measurement procedures. The assessment program should focus attention on at least two methodological questions. These questions are:

1. What is the reliability of measurement procedures used?
2. What is the relevance of the training and/or testing environment to the “real world”?

II. It is further recommended that this group consider the following specific areas of concern:

A. The evaluation of visual performance in glare conditions.
B. The evaluation of visual acuity in low-contrast conditions.
C. The development and evaluation of specialized peripheral tests,
especially with respect to performance in localizing objects and with respect to the "Westheimer" function and other new psychophysical tests.

D. The visual localization of a stimulus presented to a scotomatous area of the visual field.

E. The relative importance of color vision for low vision individuals and individuals with normal vision.

F. The phenomenon of dark adaptation in low vision individuals.

G. The dynamic resolution in the foveal and peripheral retina.

H. The measurement of accommodation and convergence in low vision individuals, both in active visual situations and under dark-field resting conditions.

I. The relationship between accommodative and convergence resting states and near and far visual acuity performance.

J. The relationship of interactions between the visual and vestibular systems to visually guided behavior.

K. Determine the learning capacities of low vision individuals and develop screening methods for the specialized problems.

L. The use of computer-generated images and infinity optics to provide a 120° dynamic visual field for low vision training and research. With the feedback from a two-dimensional treadmill, this should provide a safe mobility environment with complete flexibility of varying the visual stimuli.

M. The development of laboratory situations and tests that may be used for evaluations and for pre-street testing of individuals.

Recommendations from Group 2
(Concerning Visual Training without Aids)

I. Visual Training Programs. – Given the current state of knowledge concerning the training of low vision individuals, any recommendations should be taken as requiring validation with empirical research. Yet there are a number of recommendations which currently appear warranted. These include:

A. Orientation and mobility instructors should be guided by the following considerations in developing training procedures:

1. The training should be centered on tasks which are as close as possible to the ultimate level of perceptual functioning. While some currently used perceptual training programs may be useful, they are very often too far removed from the criterion performance to be readily generalizable.

2. Where the training task does differ from the actual real-life performance the instructor should give attention as to how to generalize learning from the training situation to the real-life situation. An example of this would be to move the individual
back and forth between the training situation and the real-life situation.

3. It is often useful, in perceptual training, to begin with exaggerated differences in the critical stimulus dimension and gradually reduce these differences as training proceeds and performance improves. For example, it may be useful to accentuate a particular stimulus dimension's critical property by adding redundant information (e.g., color coding information). However, caution should be used in doing this because the individual might become too dependent upon the redundant information with a subsequent reduction in performance when the redundancy is removed.

B. Motion pictures should be evaluated as a low-cost perceptual previewing technique.

C. A Brunswikian assortment of perceptual stimuli should be evaluated, both for individuals and groups, to be used as a tool for focusing on particular perceptual problems.

II. Professional Training Courses. — University and other programs for the professional training of orientation and mobility instructors should include formal courses in practically oriented perception, with emphasis on vision and visual development.

Recommendations from Group 3
(Concerning Visual Training with Optical Aids: One Facet of Low Vision Services)

I. Communication. — It is recommended that an effective vehicle of communication be established to facilitate the flow of information among members of the Low Vision team and among Low Vision clinics. This could maximize services to low vision individuals by ensuring that:

A. Information concerning the development of new medical techniques affecting certain etiologies of visual impairment is generally available. This is of special significance wherever dialogue does not exist between optometrists and ophthalmologists.

B. Information concerning the availability of new Low Vision aids and systems is available to low vision persons regardless of the geographic location of the facility providing them low vision services.

C. A forum exists for discussion of various aspects of low vision service such as teaching methods, relative merits of available low vision aids and systems in enhancing residual vision of specific etiology, standard diagnostic and inventory equipment most needed in establishing a low vision clinic, etc.

D. Persons with progressive conditions and/or conditions which
may be arrested or improved by medical/surgical treatment receive appropriate low vision services.

E. Long term effects of use of sophisticated low vision systems upon the physiology and function of the eyes be examined.

These and other concerns are currently being dealt with by members of individual clinics, and interdisciplinary exchanges are occurring as publications sponsored by the various disciplines contain articles and opinions submitted by representatives of other disciplines. However, we believe this dialogue would be facilitated by the establishment of an appropriate forum. Alternatively, one of the currently operative periodicals — agreeable to all representatives of low vision services — might serve this function (e.g., "Low Vision Clinic" appearing in the Optometric Weekly, The New Outlook for the Blind, or Low Vision Abstracts).

II. Legal Implications. — The legal implications of implementation of low vision services should be examined in the following areas:

A. The status of disability regarding Social Security and other benefits.

B. Current Internal Revenue Service rulings regarding qualification for blindness exemptions.

C. Current employment hiring and insurance exemptions.

D. Liability related to low vision rehabilitation programs involving ambulation with high magnification—telescopic—and/or minification systems. In addition to pedestrian activities, training programs might involve bicycling, sports and recreational activities, and motor vehicle operation.

E. Requirements for obtaining driver's licenses as they relate to low vision persons, particularly those cases which are borderline according to current regulations and involve younger, mentally alert low vision individuals who are in generally good health.

III. Low Vision Testing. — A task oriented functional vision test needs to be developed. This test should be correlated with standardized visual acuity and field tests, or used in place of these tests as needed in the low vision clinic.

IV. Dispensing. — An alternative to the incidence of single discipline, frequently non-medical/non-optometric, dispensing of low vision aids is needed. So, too, is needed an alternative program to the dispensing of complex low vision aids and systems without provision for training in the use of these aids and systems.

V. Funding. — Funding does not currently cover low vision services under state and/or local service agencies to persons within the preschool,
school age, or geriatric categories. Such funding needs to be available for diagnostic and training services, in addition to funding for low vision aids and systems.

A. Dialogue needs to be established at a high level to secure assistance from sources for the funding of public school systems in providing low vision services to children.

B. Similarly, at all levels of society, funded programs exist to provide needed services to older people. Coordinated efforts, at a high level, are needed to supplement funding for low vision services recently made available through Medicare.

Research

VI. Research into the development and implementation of medical and surgical techniques to cure and control the conditions from which, in many cases, low vision stems is, of course, a continuing need.

VII. For those to whom diminished vision must continue to be a reality, the urgent need is for further development of low vision aids and systems which can maximize the effectiveness of available residual vision. The more cosmetically unobtrusive these low vision aids and systems can be, the greater the likelihood that they will be used. There is a great need for the designing of aids with higher magnification while maintaining large fields of view.

VIII. Coordination between efforts directed toward research and development of low vision aids and systems, and the learning tasks prerequisite to integration of these aids and systems, must occur.

IX. Interdisciplinary research teams are by nature unwieldy. However, low vision involves the total life experience of affected individuals, and such an interdisciplinary approach can be expected to yield more pragmatic results.

X. Eccentric Viewing. — Research is needed in the area of eccentric viewing. Techniques need to be developed which will allow the client more effective reception of visual stimuli falling on the peripheral retina.

Recommendations from Group 4
(Concerning a Functional Evaluation of Distance Vision with Optical Aids)

Factor Identification

I. Studies should be undertaken to identify, describe, and assess the factors specifically related to visual skills as they bear on low vision
performance. These factors should then be incorporated into a composite evaluation approach.

II. A profile of factors which are related to orientation and mobility success should be developed so that the prediction of performance can be enhanced and adequate treatment can be planned.

Methodological Considerations

III. The complementary evaluation approaches discussed in this section (as well as others) need to be further developed, and then articulated in a manner that facilitates scoring within the context of the low vision person operating in real-life situations.

IV. Efforts at developing evaluation methodologies for adult low vision individuals should be paralleled by similar efforts for young, aged, and multi-handicapped low vision individuals.

V. Funding. — The work which needs to be done is of a nature that warrants long-term support, inasmuch as it is heuristic in nature. Wherever possible, studies should therefore be planned to span three-year periods to allow for this iterative process to take place.

Recommendations from Group 5
(Concerning the Low Vision Person—"The Marginal Man")

I. Public Education. — Many of the psychosocial problems that accompany low vision are related to the difficulties that the general public experiences in understanding the abilities and limitations of the low vision person. Consequently, we recommend that rehabilitation professionals and low vision persons develop public education programs and an interest group of low vision persons to publicize the nature of low vision and advocate a better understanding of this condition and improved services. Such information might be effectively spread through the discussion of low vision in the advertising of optical companies, optometry and ophthalmology associations, the United Way, rehabilitation and service organizations, and on popular television shows.

II. Family Programs. — Many low vision individuals have difficulty with establishing and/or maintaining a realistic self-concept. Since the self-concept is a reactive mechanism, it is strongly affected by the expectations of family members and close associates of the low vision person. Therefore, we recommend that rehabilitation efforts for low vision persons incorporate the maximum feasible participation of the family members and close associates.
Factors Affecting Performance

III. The ability of the low vision person to learn to use his vision efficiently and to learn how to perform the various tasks of daily living including independent mobility may be affected by a variety of psychosocial factors. These include:

A. Basic personality dynamics (i.e., dependent vs. independent, introverted vs. extroverted).
B. The strains of adjusting to the condition of low vision, including preoccupation with problems and changing roles.
C. The anxiety of entering new situations and interacting with people, particularly as these are affected by the unpredictability of visual functioning in many situations.

Therefore, we recommend that persons who are training the low vision person to use his vision, or to cope with the various activities of daily living, be concerned with how these factors are influencing the low vision person's functioning. They should assist the person in using the various resources that might aid in overcoming these factors, especially an interdisciplinary team, including professionals in the psychosocial disciplines.

IV. Since the rehabilitation specialist frequently talks with the low vision person about his visual condition and its effects, we recommend that the specialist have sufficient knowledge about the limitations caused by various eye conditions so that he is able to evaluate how the person perceives his own condition and is able to facilitate the person in achieving a realistic assessment of that condition.

V. Since it sometimes happens that a low vision person will appear to function with less (or more) vision than he theoretically should have, the rehabilitation specialist must be sensitive to problems in this area. We recommend that rehabilitation specialists attempt to help the person function visually to his maximum potential, but that the process of helping an individual come to an open acceptance of what he can and cannot see must incorporate a delicate balance in timing and approach that recognizes the importance of vision in the overall personality dynamics and social situation of the individual, including its effects on the person's economics and eligibility for services.

VI. Employment. — In the placement of low vision persons in occupational situations, we recommend several areas in which additional research or study can provide data which could materially assist the rehabilitation agency in effecting good placement. They include:

A. A determination of the job environment (on the job, as well as travel to and from the job) necessary for the low vision individual
to function with a reasonable degree of mobility, productive job performance and safety.

B. The identification and analysis of jobs upon which the low vision person can perform in a meaningful manner considering the level of his current visual skills and the demands of the position. This analysis should provide the rehabilitation agency with specific job requirements for use in training prior to placement.

C. A determination of methods and materials for use in orienting future superiors and co-workers within the employing organization concerning the low vision individual's unique qualifications, the nature of his visual impairments, his ability to function in the working situation and the desired cooperation required to assimilate him into the work situation.

VII. Low Vision Simulation. — The use of equipment simulating low vision conditions can be helpful to family members, professionals, the general public, employers, and co-workers in achieving a better appreciation of the situation of low vision persons. We recommend the development and dissemination of this equipment for use in training programs and public education programs, particularly in talks to service clubs and other organizations.

VIII. Rehabilitation Goal. — We recommend that all rehabilitation efforts be aimed at maintaining (or returning) each low vision person into the mainstream of society with a good understanding and acceptance of his condition and the ability to relate this comfortably to others.

Summary

The recommendations made by the participants of the Workshop on Low Vision Mobility clearly indicate the need for continued efforts in the field of low vision. Some of the recommendations will be fulfilled with the acquisition of knowledge gained in the day-to-day activity of providing low vision services. Other recommendations will require a more directed effort with the concomitant needs for funding and manpower. It is our hope that this workshop will contribute to the initiation of that needed effort.

ACKNOWLEDGMENTS

This final report of the workshop on Low Vision Mobility that was held at Western Michigan University, Kalamazoo, Michigan, November 3–5 1975, represents the diligent work of many individuals, especially the participants. However, the co-directors wish to give special acknowledgments to several individuals who contributed significantly to the
success of the workshop.

We are particularly grateful to the Research Center for Prosthetics of the Veterans Administration, New York, N.Y., who furnished the conference with both moral and financial support when it appeared that the National Research Council would not be able to sponsor the workshop because of its reorganization. Veterans Administration sponsorship is very much in keeping with their highly developed programs in the low vision area. We are especially indebted to Peter Nelson from the National Research Council, Committee on Prosthetics Research and Development, Washington, D.C., who did much of the ground work on planning and organizing the workshop. However, due to funding reassignment he was unable to see the fruits of all his efforts. Secondly, we would like to express our appreciation to Donald Blasch, Director of the Department of Blind Rehabilitation, and George Mallinson, Dean of the School of Graduate Studies, who made all the arrangements at Western Michigan University without neglecting any items. These skillful arrangements greatly facilitated maximum output from all the participants.

One facet of the workshop which amazed all of the participants was the speed at which the conference papers were retyped and redistributed to them. This is entirely attributed to the diligent and hardworking efforts of Sylvia Carson, Suzette Hampton, and Ann Wideeleea, Western Michigan University Staff.

Many thanks go to conference participant Gregory L. Goodrich, Ph.D., Western Blind Rehabilitation Center, Veterans Administration Hospital, Palo Alto, California, who prepared the Summary of Conference Recommendations found in the final chapter. Also deserving special thanks is Marianne M. Apple, Editor, Low Vision Abstracts, Westfield, New Jersey, for her work in organizing and structuring the proceedings.

The report in its final form would not have been possible without the outstanding efforts of the workshop editors, Dr. Eugene F. Murphy and Howard Freiberger of the Veterans Administration Research Center for Prosthetics, New York, N.Y. As everyone realizes, it is certainly no easy task to take items of material and consolidate them into a precise, meaningful, and distinct publication.

Finally, we would like to express our appreciation to all the planning committee members and participants. Every workshop participant, without exception, worked well beyond what was normally expected of any individual attending a conference. Each participant exerted a maximum effort, and many worked into the early hours of the morning revising and refining the various sub-group papers. Needless to say, this type of “working workshop” produces a great deal of enthusiasm, learning, and benefit to all individuals, not only to those participating, but
Apple and Blasch: Workshop on Low Vision Mobility

hopefully also to those reading this final report.

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"Visual Training Without Aids"


Apple and Blasch: Workshop on Low Vision Mobility


"Visual Training with Optical Aids: One Facet of Low Vision Service"


"The Low Vision Person (Psychosocial Aspects of Low Vision)"


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