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A Comparison of Reading and Listening Performances of Braille and Print Readers

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A COMPARISON OF READING AND LISTENING PERFORMANCES OF BRAILLE AND PRINT READERS

by

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Blind and sighted subjects were tested on their capability to retain information after both reading and listening to specially prepared printed and taped materials. The sample consisted of graduate students and professional individuals. It was found that, on the average, subjects retained more after reading than listening. This effect was more pronounced in the braille reading subjects. As the level of complexity of the material increased, the difference in the points earned between the two modalities, reading and listening, increased significantly. A behavioral analysis suggested some reasons for this difference. It was suggested that further research into reading and listening skills would have implications for teaching methodology, especially for blind students.

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INTRODUCTION

According to scientific theory, most of the information which is gathered by human observation is acquired through the sense of vision; the sense of hearing provides a weak second (Bennet, Note 1). Also, Drennen (1970) has stated that the sense of hearing is our keenest sense and provides the widest range of information. If we reduce the scope of inquiry to the effects on learning by the two major modes of presentation (printed and aural), we find that there have been few studies designed to investigate the two avenues of learning as they are used throughout life. Drennen continues:

> Our sense of hearing is by far more sophisticated than our sense of sight, because we can detect a much wider range of stimuli with our ears than we can with our eyes; several octaves of sound, while out eyes are sensitive to only one octave of light. (p. 63)

Developmental theory proposes that listening competency precedes reading competency in children; when decoding skills are thoroughly mastered at the adult level, reading and listening comprehension become comparable (Smiley, Oakley, Worthen, Campione, & Brown, 1979). The basic processes that underlie the essential skills of comprehension have been largely unexplored. The class of human behavior, language processing, is encompassed within the broad general field of human information processing; however, research investigating the two major subclasses (reading and listening) have yielded mixed results.

Studies comparing reading and listening generally produce conclusions of three types: (a) reading is the preferred mode for presentation; (b) listening is the preferred mode; (c) there is no significant difference between the two. Various combinations of techniques have been investigated in an attempt to maximize student learning. Many of the studies, however, have ignored individual differences in learning histories, while attempting to ascertain the most appropriate instructional media (Fronk, 1975).

Persons who seek information concerning the relative superiority of one technique over the other would have difficulty in deciding which mode to use. In conventional curricula, a great deal of instruction is given in reading skills, and much less is given in listening skills. Not much is known about how to give effective instruction in listening skills. Most teachers simply assume that children know how to listen (Breiter, 1975).

Apart from the obvious physical characteristics of reading, it is unknown how reading differs from the listening process. While it has been suggested that reading, listening, speaking, and writing are all thinking activities, and that the taxonomies of reading and listening comprehension skills are similar, reading is a unique activity insofar as it involves the visual and tactile reception and interpretation of information signaled by the written langauge ((Walker, 1976) there was no such distinguishable singular phenomenon as reading comprehension, but a general process of comprehension which applies equally to both reading and listening. The precise domain of the reading activity and the variable chosen for investigation (as well as those of listening) may account for the contradictory results in this type of research.

When the two types of instruction were compared using texts of equal difficulty, of the 670 sixth-grade students in the sample, the average and above average intelligence students learned more from reading than from listening (Breiter, 1975). Additionally, girls learned more from reading than listening, while boys learned more from listening than girls. In this study, knowledge, facts, concepts, and generalization were assessed.

An investigation of 118 middle-school children in Leeds, England utilized a somewhat different approach (Neville, 1975). The subjects were divided into two groups and three passages of equal difficulty were presented to each group. Subjects in the first group could read the passages with a simultaneous presentation of the material on audiotape. The second group had no accompanying reading material. Both groups were subjected to three variations in the speed at which aural material was presented: (a) a normal speed set at 180 words per minute; (b) a compressed speed set at 125% of the normal rate; and (c) an expanded rate set at 75% of the normal rate. No significant differences were found in the listening alone group relative to the rate of the passage, as shown by test scores on comprehensive questions. In the group where the aural presentation was accompanied by reading matter, higher scores were associated with slower rates. When the two groups were compared overall, scores were slightly higher for the group that had reading plus aural presentation.

Hartman (1961a, 1961b) concluded that a combination of delivery techniques was more effective than presentation of the same information in either channel alone. In an attempt to clarify the conflicting information found in the listening and reading research, Duker (1965) presented 11 generalizations, one of which was that more comprehension occurred with combined printed and aural presentations.

Many researchers, however, have not supported these contentions (Conway, 1967; Holliday, 1971; Severens, 1967a, 1967b; Van Mondfrans & Travers, 1964). The Holliday (1971) study examined the advantages of presenting verbal information using simultaneous audio and printed media compared with either audio or printed material alone. No significant learning advantage was found when material was presented simultaneously, or when redundant information was presented in simultaneous combinations.

Van Mondfrans and Travers' (1964) explanation of similar experimental results contended that the redundant information, presented through one of the two media, never gained access to the brain. When Severens (1967a) studied simultaneous presentations, he also found no advantage in presenting redundant material, and explained it by the cue summation theory, which states that if more learning is to take place, additional information or cues must be provided through one of the two media components.

Conway (1967), in his review of the research, also reported on the contradictory findings and attributed them to statistical and methodological flaws; no test of significance; absence of control for the time of exposure to the material; and, selection of test material. In fact, according to a review of multimedia research

(Briggs, Campeau, Gagne & May, 1977), most investigators have neglected certain methodological considerations, such as: questionably stated conclusions; few controls for differences in prior knowledge; non-random selection of subjects; off-the-shelf instead of specially prepared materials; and the importance of the classroom teacher in the experimental setting.

Subsequent studies addressed the issue from a different approach; that of comparing the relative efficacy of each of the two major modes of presentation, reading and listening (Berger & Perfetti, 1977; Smiley et al., 1977; Walker, 1975). Walker (1975) randomly divided three independent samples of 11th-grade students into two treatment groups. One treatment was a listening task involving a videotaped discussion between two students, while the second treatment used a written version of the same discussion. There were three such paired versions, a different pair for each sample. Under identical conditions, subjects in both treatments wrote down all they could recall of the discussion. The recalled texts of the readers, relative to those of the listeners, were characterized by more non-distorted ideas, displayed more of the appropriate relationships found in the original, and a lower proportion of incorrect response units which were contributed extraneously by the subjects.

Two separate studies (Berger & Perfetti, 1977; Smiley et al., 1977) compared the performance of high and low skilled fifth- and seventh-grade readers when each group was given a memory task following audio and printed presentations. The magnitude of difference between good and poor readers was large in terms of the total amount recalled, but there was no significant difference between the two modes of presentation within the same reading skills group. The data were interpreted as being consistent with the assumption that auditory and reading comprehension depend on the same basic processes, and that a deficit in language comprehension implies that poor readers are also poor listeners.

Previous studies used exclusively sighted subjects. In what seems to be the only study using exclusively blind subjects, Tuttle (1972) tried to identify the most efficient method of learning for non-sighted persons: reading by braille, listening to tapes of normal rate speech, or listening to tapes of compressed speech. The average braille reading speed was 104 words-per-minute, normal recorded speech was 175 words-per-minute, while compressed speech was 275 words-per-minute. The average print reading rate for sighted high school students was reported to be 250 to 300 words-per-minute. The subjects were high school students in the California school system who wach took three equivalent forms of the Reading Versatility Test, Intermediate Level. One form was presented in braille and the other two on audiotapes at the two different speeds. There was no difference in the comprehension level for the three presentations. An index of learning efficiency was computed by dividing the number of correct responses by the number of minutes spent reading or listening to the material, and designated as the comprehension score per unit of time.

While material presented in braille form took three times as long to learn as that presented as compressed speech on audiotape, and twice as long as that material presented at a normal rate, the author contends that braille is still the most exact medium of learning for the blind. Tuttle commented on the large individual differences between subjects' comprehension as a function of the different forms of presentation.

The present study investigated the effects of reading vs. listening on memory and recall. The term reading includes the tactile perception of braille and the visual perception of conventional print. The term listening encompasses the aural perception of speech.

In the research reported in the literature concerning the efficacy of the two major modes of textual presentation, most of the studies have involved school children while little research has been directed toward the adult population. The specific subject population that has been almost completely ignored by researchers is the braille reading population. Discrepancies among the research findings may have resulted from methodological flaws as well as neglect of adult braille-reading individuals.

The design of the present study included the following aspects: (a) subjects included both print and braille reading adults; (b) the effects of prior knowledge were controlled by selecting material unlikely to be encountered in everyday life; (c) the material was chosen for both the complexity and comprehension level; (d) questions were categorized according to the level of skill required to answer them; (e) subjects were randomly assigned to alternate treatments to control for order and sequence effects; and (f) individual and group variability were assessed by a statistical test of significance.

CHAPTER II

METHOD

Subjects

Of the 28 adult subjects (14 males and 14 females), 10 were braille readers, and the remaining 18 used the typical printed form. The educational level of the subject population consisted of students engaged in various graduate programs, and persons with graduate degrees working in a professional capacity. A few upper-level undergraduate students were included. Scholastic backgrounds included such diverse fields as agriculture, business administration, medicine, and psychology (see Table I). Colleges and universities conferring the degrees included a wide range of geographical locations and curricular ideologies (see Table I). The process of subject selection was achieved by means of announcements, invitations, and recruitments, while keeping in mind the parameters of the population description.

Procedure

Materials

Materials for this project were compiled from excerpts of a lecture which were presented by Dr. Milton Alter, Chairman of the Department of Neurology, Temple University Medical School, Philadelphia, Pennsylvania. The lecture was presented to the REMS (Recreation and

TABLE I

EDUCATIONAL BACKGROUNDS

Subject	Degree	College/University	Field of Study
1	BS	Kentucky State U.	Biology
	MS	Iowa State U.	Botany/Plant Pathology
	MA	Western Michigan U.	Blind Rehab. Teaching
	PhD	Iowa State U.	Botany/Plant Pathology
2	N/A	Western Michigan U.	Social Work
3	BA	Grand Valley State Col.	Blind Rehab.
4	BSW	Western Michigan U.	Social Work
5	MA	Michigan State U.	English
6	BA	Western Michigan U.	Social Work
	MA	Western Michigan U.	Blind Rehab. Teaching
7	BA	Grand Valley State Col.	Behavioral Sciences
	MA	Michigan State U.	Vocational Rehab.
8	BSW	Western Michigan U.	Social Work
9	N/A	Western Michigan U.	Social Work
10	BA	Western Michigan U.	English
	MA	Western Michigan U.	Communications
11	BS	Alma Col.	Biology
	MS	Central Michigan U.	Physiology
	N/A	Michigan State U.	Medicine
12	BA	Not listed	English/French
13	BA	Michigan State U.	Agricultural Econ.
	MA	Michigan State U.	Accounting
14	BA	Michigan State U.	Communications
15	AA	Wittenburg U.	Business Administration
16	BA	Washington & Jefferson	Not listed
	MS	Michigan State U.	Agricultural Econ./ African Lang.

TABLE I
(Continued)

Subject	Degree	College/University	Field of Study
17	MA	Michigan State U.	Botany/Plant Ecology
	PhD	Michigan State U.	Entomology
18	BS	Michigan State U.	Therapeutic Rec.
19	BS	Alma C.	Biology
	MS	Wayne State U.	Occupational/ Environmental Health
20	BS	Michigan State U.	Biology
	CLS	Michigan State U.	Medical Technology
21	BA	Central Michigan U.	Child Development
22	BS	Central Michigan U.	Biology
23	BS	Central Michigan U.	Not listed
24	BS	Indiana State U.	Elementary Music Ed.
25	BS	Indiana State U.	Recreation
26	BA	Elmhurst C.	Not listed
	MDiv	Eden Theological Sem.	Theology
	MSW	Washington U.	Social Work
27	BA	Western Michigan U.	Education
28	BA	Western Michigan U.	Applied Psychology
	MA	Western Michigan U.	Clinical Psychology

Education for Multiple Sclerosis group), the Kalamazoo Regional District. Since this was a limited audience, it was possible to be certain that none of the subject population had any previous exposure to the research materials. The subject matter included material that was both complex and readily understandable. An additional element lending to the ease of understanding was that the original material was prepared specifically for formal listening, providing an advantage to the listener over the reader, rather than the formal printed media utilized in previous investigations. These utilized formal printed media, providing an advantage to the reader rather than the listener. There are linguistic differences in the manner in which information is prepared for formal writing and the process of spontaneous speech; the former requiring greater structure and prevision in conveying the verbal message (Walker, 1976).

Materials preparation

The entire lecture was recorded on a high quality GE, APH Model 3-5194 cassette recorder and then transcribed, verbatim. The complete text was divided into two consecutive sections, nearly equal in length. Each of the sections was subsequently retyped, having deleted some of the extraneous and often redundant portions. However, within the material remaining, the precise wording of the lecturer was retained. The changes made were those of dropping an occasional conjunction, in order to end a sentence and punctuate with a period; or, to furnish an introductory word or phrase to a sentence, following a deletion (see Appendices A and B).

Since the original presentation was accompanied by slides, any reference to these were changed to the conditional; for example, from "Here we see..." to "If we were to look at..." The first half of the material, headed Section 1, was prepared for the reading task and comprised three and one-half typewritten, photocopied pages (elite type), or six and one-half thermoformed, braille pages. The second half of the material, headed Section 2, was prepared for the listening task. This was read by a research assistant onto the same cassette recorder as was used to make the original recording. The tape was played on this same piece of equipment throughout the study, for the purpose of ensuring standardization. The length of the recording was nine minutes and forty-five seconds.

Measurement

Two sets of 24 questions were generated to parallel each of the two sections, and varying point values were assigned to each question, making a total of 40 points for each section. Point values were determined by the number of parts to a specific question and the level of difficulty of the answer. Recall-type questions, Category Level 1, required a simple verbatim response of one or two words. The memory retention-type questions, Level 2, required a greater degree of integration of information. Level 3 questions, covering the most complex retention items, demanded an intensive level of attending and synthesis of the subject matter, in order to present a correct response (see Appendices C and D).

Testing

Each subject read and signed an informed consent form and provided background information. Since testing times were set for the convenience of the subjects, some tests were given individually, while others were given to small groups. On all occasions, the directions were made consistent by playing a standardized instructional cassette tape. This tape was played before each testing session on the same tape player, eliminating the possibility of variation in expression, time, and emphasis.

As the subjects completed each section, the materials were removed and a set of questions paralleling the section was provided to the subject, either in print or braille form, according to the specific textual needs of the individual. Both sections were completed in one session. A strict time limit was not established; however, not a great deal of variation was observed within the particular medium. Between the two media, braille users, as a general rule, took longer; on the average, sighted subjects took 50 minutes, while blind subjects took 75 minutes.

The order of presentation was alternated to control for any order or sequence effects. All participants were randomly assigned a subject number. All odd-numbered subjects, Subject 1, Subject 3, etc., read Section 1 first; even-numbered subjects, Subject 2, Subject 4, etc., listened to Section 2 first. Each time, this was followed by the other section.

Reliability

Reliability checks were made by an independent observer on the written responses of all of the subjects. All data were transcribed by an independent transcribing organization (Battle Creek Braille Transcribers) into the other print form (braille into print, print into braille) to permit assessment by both blind and sighted observers.

Two types of interobserver reliability were calculated: (a) overall percent agreement, the smaller score divided by the larger score, multiplied by 100 (smaller score/larger score x 100); and (b) the number of points agreed upon per answer or question item, divided by the number agreed upon plus disagreed upon, multiplied by 100 $(\frac{\text{Agreements}}{\text{Agreements + Disagreements}} \times 100)$. The answer sheets were scored point by point. An agreement was scored only if both observers agreed exactly on each point or fraction thereof.

CHAPTER III

RESULTS

Analysis was carried out on the total number of points (dependent variable) achieved on the test by each subject. Two approaches to the analysis of the data were conducted, a logical description and a statistical test of significance. The statistical analyses were made using the BMDP (Biomedical Data Programs) Statistical Package; in particular, the analysis of variance--the 2-V procedure--was used. The data were analyzed as a repeated measures design, with one grouping factor and two trial factors. The grouping factor was whether the subjects were braille or print readers. The first trial factor consisted of the mode: reading or listening. The second trial factor concerned the level of complexity.

The first statistical test, between subjects, was not found to be significant. There was no significant difference between braille and print readers, however, the braille readers did have substantially higher mean reading scores.

The second statistical test, within subjects (Factor B), tested the difference between modes: reading or listening. A significant difference was found, $\underline{p} = .0035$. This indicates that there is a strong difference between reading and listening modalities; when looking at the group means, the reading group mean was higher, indicating that reading is the more effective mode (see Table II).

The main effects for the level of difficulty were significant,

TABLE II

SUMMARY OF ANALYSIS OF VARIANCE

Source of Variation	Computational Formula	SS	df	MS	F
<u>Between Subjects</u>	(10)-(1)				
A (code)	(3)-(1)	0.38345	1	0.38345	1.313
Subjects $\bar{w}$/in groups (error a)	(10)-(3)	32.11181	110	0.29193	$p < .5$
<u>Within Subjects</u>	(2)-(10)				$p = .0035$
B (mode)	(4)-(1)	1.58304	1	1.58304	8.886
A x B	(6)-(3)-(4)+(1)	0.00587	1	0.00587	0.032
B x Sub $\bar{w}$/in groups (error b)	(11)-(6)-(10)+(3)	19.59616	110	0.12815	$p = .8$
					$p = .0000$
C (Q level)	(5)-(1)	10.42598	2	5.21299	39.78
A x C	(7)-(3)-(5)+(1)	0.47684	2	0.23842	1.819
C x Sub $\bar{w}$/in groups (error c)	(12)-(7)-(10)+(3)	28.82651	220	0.13103	
					$p = .2311$
B x C (interaction)	(8)-(4)-(5)+(1)	10.42598	2	0.20101	1.47
A x B x C	(9)-(6)-(7)-(8)+(3)+(4)+(5)-(1)	0.00696	2	0.00348	$p = .97$ 0.03
(b)(c) x Sub $\bar{w}$/in groups	(2)-(9)-(11)-(12)+(6)+(7)+(10)-(3)	29.98499	229	0.1363	

$p > .0001$. The level of complexity was a very important factor in how well the subjects responded to questions. Regardless of whether the material was read or listened to, the response scores decreased as complexity increased; but, in all levels, the readers as a group scored higher than the listeners. Tests for interaction effects on all possible combinations of Factors A, B, and C were carried out; there were no significant interactions found in any of the combinations: (A) x (C), $p = .165$; (B) x (C), $p = .231$; (A) x (B) x (C), $p = .974$.

Of the 10 braille readers (Subjects 1-10), six obtained a higher score in reading, four in listening. Among the 18 print readers (Subjects 11-18), nine received a higher score on reading, eight listening, and one with exactly the same score on each section.

The group means of the raw score values for the reading section were: braille readers, 20.24; print readers, 17.39; total group, 18.40. For the listening section, the group means were: braille users,17.02; print users, 16.47; total group, 16.67 (see Table III).

Figure 1 shows the total points earned for each subject on both validity tests. Raw scores ranged from 9.5 to 32.5 for braille readers, and from 5.5 to 29.5 for print readers. On the listening section, the two groups ranged from 6 to 27, and from 7 to 25.75, respectively. Individual subjects obtained comparative scores ranging from that of Subject 7, a braille reader who had scores of 9.5 for the reading section and 9.75 for the listening section, to that of Subject 4, 32.5 and 20, reading to listening. Print users ranged from that of Subject 25, 5.5 reading and 7 listening, to Subject 16 with 29.25 reading and 27.25 listening. Figures 2 and 3 compare the difference

TABLE III

COMPARATIVE GROUP MEANS FOR ALL LEVELS OF EACH MODALITY

Group	Number of Questions	Number of Points	Total Pts. Possible	Total Pts. Earned	Single Q. Mean	Total Level Mean
Reading Section						
Braille Ss						
Level 1 Q.	10	10	100	72.373	.72375	7.2375
Level 2 Q.	7	12	120	55.5	.4625	3.2375
Level 3 Q.	7	18	180	72.5	.4027	2.8198
Print Ss						
Level 1 Q.	10	10	180	103.45	.5747	5.747
Level 2 Q.	7	12	216	75.5	.3495	2.4465
Level 3 Q.	7	18	324	115.75	.3572	2.5004
Total S's						
Level 1 Q.	10	10	280	175.83	.6279	6.279
Level 2 Q.	7	12	336	131	.3898	2.7286
Level 3 Q.	7	18	504	188.25	.3735	2.6145
Listening Section						
Braille Ss						
Level 1	12	12	120	65.75	.5479	6.5748
Level 2	8	18	180	81	.45	3.6
Level 3	4	10	100	24	.24	.96
Print Ss						
Level 1	12	12	216	108.25	.5011	6.0132
Level 2	8	18	324	96.25	.297	2.376
Level 3	4	10	180	45	.25	1.0

TABLE III
(Continued)

Group	Number of Questions	Number of Points	Total Pts. Possible	Total Pts. Earned	Single Q. Mean	Total Level Mean
Total Ss						
Level 1	12	12	336	174	.5178	6.2136
Level 2	8	18	504	177.25	.3156	2.8128
Level 3	4	10	280	69	.2464	.9856

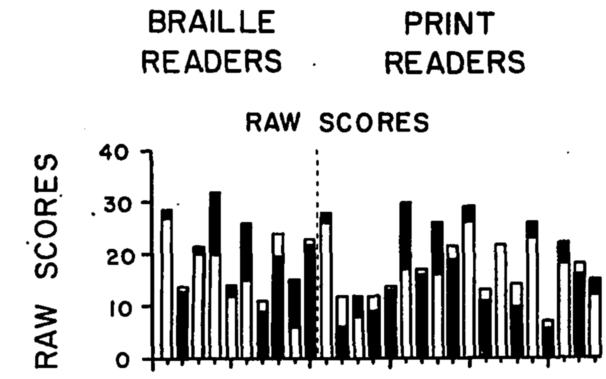

FIGURE 1

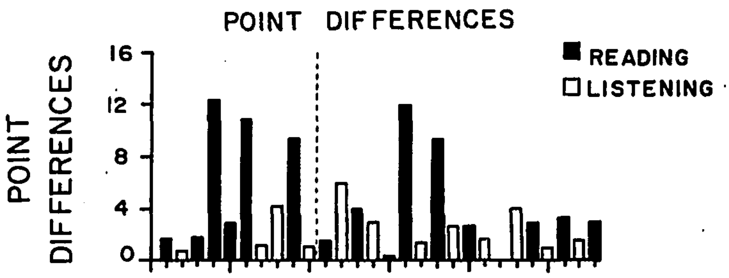

FIGURE 2

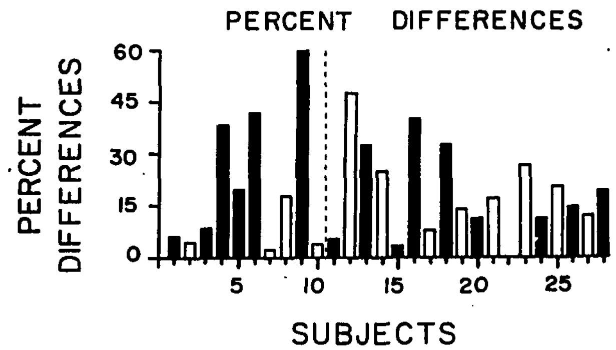

FIGURE 3

FIGURE 1. TOTAL POINTS EARNED ON RETENTION TESTS FOR EACH SUBJECT

FIGURE 2. POINT DIFFERENCES BETWEEN THE TWO MODALITIES BY INDIVIDUAL SUBJECTS

FIGURE 3. PERCENT SUPERIORITY OF MODALITY FOR INDIVIDUAL SUBJECTS

between the two modalities for an individual subject and the percent of elevation in the superior modality. The range of the point difference and the percent of difference demonstrated for the total group ranged from no difference (Subject 22) to 9.5 points difference, or 61.3% (Subject 9). Overall, those subjects with better scores on the listening scores ranged from .25 points or 2.56% difference (Subject 7), to 5.5 points or 48.9% difference (Subject 12) (see Figures 1, 2, and 3) (see Table IV).

Table V presents the two sections as they represent the three levels of difficulty: (a) the number of questions in each level; (b) the number of assigned point values; and, (c) the percent of total points or the proportion which that particular level of difficulty represented in that section. There were 10 questions with a possible 10 points in the Level 1 reading section; 12 questions for 12 points possible in the Level 1 listening section. Out of the 280 total possible points for the Level 1 reading section (28 subjects x 10 points), there were 175.83 earned, representing a mean of .6279 for the total Level 1 reading questions. Correspondingly, for listening, of 336 possible Level 1 points, 174 were earned, with a .5178 mean for a single Level 1 question, with a total Level 1 listening mean of 6.2136. The mean value earned for a Level 2 question was .3898 and .3516, reading over listening. For a Level 3 question, the mean points per question were .3735 reading and .2464 listening. The obtained level means for the total Level 3 questions were 2.6145 for reading, and .9856 for listening (see Table III).

TABLE IV

LEVEL OF DIFFICULTY AND PROPORTION OF ASSIGNED POINT VALUES FOR EACH MODALITY

Level	Number of Questions	Number of Points	Percentage of Total Questions	Percentage of Total Points
Section 1				
1	10	10	42%	29%
2	7	12	29%	30%
3	7	18	29%	45%
Section 2				
1	12	12	50%	30%
2	8	18	33%	45%
3	4	10	17%	25%

TABLE V

RAW SCORES, POINT DIFFERENCES, AND PERCENTAGE DIFFERENTIALS FOR ALL SUBJECTS

Subjects	Reading Score	Listening Score	Point Dif.	Percent Dif.
1	28.75	27	1.75	6.25
2	13.12	13.75	.63	4.59
3	21.5	19.75	1.75	8.13
4	32.5	20	12.5	38.46
5	14.5	11.75	2.75	18.96
6	25.75	14.75	11	42.71
7	9.5	9.75	.25	2.56
8	19.75	24	4.25	17.7
9	15.5	6	9.5	61.29
10	21.5	22.5	1	4.44
11	27.125	25.75	1.375	5.06
12	6	11.75	5.75	48.93
13	12	8	4	33.33
14	9	12	3	25
15	13.5	13	.5	3.7
16	29.25	17.25	12	41.05
17	15.75	17.25	12	41.02
18	26	16.5	9.5	36.53
19	19	22.25	3.25	14.6
20	28.75	25.5	3.25	11.3
21	11	13.25	2.25	16.98
22	21.5	21.5	0.0	0.0
23	10	14	4	27.35
24	26	23	3	11.53
25	5.5	7	1.5	21.42
26	21.83	18.5	3.33	15.25
27	15.75	18	2.25	12.5
28	15	12	3	20

Reliability

Type A reliability scores resulted in scores ranging from 94% to 100% in Section 1, and from 90% to 100% in Section 2. Type B scores ranged from 97% to 100%, and from 97% to 100%, respectively. The mean reliability measures for Type A and Type B across all subjects and both sections were 99%, each (see Table VI).

TABLE VI

INTEROBSERVER RELIABILITY: ALL SUBJECTS

	Section 1		Section 2	
Subjects	Reliability a	Reliability b	Reliability a	Reliability b
1	100%	100%	100%	100%
2	98%	98%	100%	100%
3	100%	100%	100%	100%
4	100%	100%	100%	100%
5	100%	100%	100%	100%
6	100%	100%	100%	100%
7	94%	98%	90%	97%
8	94%	97%	100%	100%
9	100%	100%	100%	100%
10	100%	100%	100%	100%
11	100%	100%	100%	100%
12	100%	100%	91%	98%
13	100%	100%	100%	100%
14	100%	100%	100%	100%
15	100%	100%	100%	100%
16	96%	97%	100%	100%
17	100%	100%	100%	100%
18	96%	97%	100%	100%
19	100%	100%	100%	100%
20	100%	100%	100%	100%
21	100%	100%	100%	100%
22	100%	100%	100%	100%
23	95%	98%	100%	100%
24	100%	100%	100%	100%
25	100%	100%	100%	100%
26	100%	100%	100%	100%
27	100%	100%	100%	100%
28	100%	100%	95%	98%
TOTAL	99%	99%	99%	99%

CHAPTER IV

DISCUSSION

The present study was designed for the purpose of making a comparative analysis of the functional efficacy of the two major sensory modes of media presentation (reading and listening) on the processes of recall and memory retention in the adult blind and sighted populations. It was found that reading the material, either in print or braille, was significantly more effective than listening to it on audiotape, as determined by the accuracy of the subjects' written responses to test questions.

On all three levels of difficulty of the textual material, the reading scores were higher than the listening scores; and as the complexity increased, the difference in the obtained mean scores increased. Readers were able to retain more of the unfamiliar, complex information, whether they read it in braille or print; and the trend was toward convergence, as the study material and the items to be recalled became simpler.

To permit closer scrutiny, five comparisons were made upon pairs of questions from the two sections. The first comparison was made between Reading Question 5 and Listening Question 22. Both questions required the same answer, plasmapheresis. Total points earned for readers was 28.25, for listeners, 18.25. These 10 points represent a 35.4% difference for reading over listening retention scores. Comparing responses from Reading Question 11 with Listening Question 24, the material covered for both would generally be considered both would generally be considered both unfamiliar and complex. However, the answer required for reading would appear to be much more difficult to comprehend and retain (allegofendro gliacyte, a cell in the CNS that makes myelin); whereas, the listening response required retention of a three letter response (the HLA system, a genetically determined immune system). Credit was given for any part of the answer which was correct; regardless, reading scores were elevated 67.7% over listening scores.

Three other comparisons were made: between Reading Question 21 and Listening Question 24; Reading Question 20 and Listening Question 20; and Reading Question 19 and Listening Question 20. Elevated reading scores were found in all three comparisons; 33%, 10.3%, and 7.1%, respectively (see Appendices C, D, E, and F).

This phenomenon might be partially explained by the obvious diffeences in the stimulus cue systems involved. In listening, for example, the stimuli are both temporal and ephemeral; thus, reconstruction of the verbal message is made more difficult because of a lack of control of the rate, and, perhaps more importantly, the weakness in the existing associated stimuli to be utilized. When reading, a person may control rate, and also reread portions of the text.

The graphic stimuli for reading are both static and spatial (Walker, 1976). This permits instantaneous focusing, or regression, if interpretation difficulties occur. One could expect to find potential strength in the stimulus associations availed by the spatial construction of the passage, as well as in the printing mechanisms.

For example, the spatial set-up, paragraphing, and location on the page of a particular item; printing mechanisms such as punctuation, dashes, and underlining; and accentuations apparent in headings, print variations, etc., provide concurrent stimuli to enhance the processes of learning and memory retention.

The reader has control over his/her rate of information processing. The listener must follow the speaker's rate, and even if the message is recorded, it is impossible to instantly review sections of speech because of its ephemeral nature. The process of regression, for reviewing, is extremely intrusive to the flow of meaning. It is also much more time-consuming.

As a group, the braille users (all were totally blind) obtained higher scores in both reading and listening. For those individuals, the high school and elementary school systems have provided most of their educational materials in the tactile reading form--braille--parallel to the printed form of their sighted peers. However, in the systems of higher education, this situation changes abruptly. Little or none of the text book materials, or in-class hand-outs, are ever made available in braille. Thus, blind individuals may have been forced to increase their listening efficiency as a consequence of deprivation of tactile stimuli. The difference in the two mean scores for listening were quite small.

The difference in the two groups' mean score for reading was more substantial (see Table III). The tactile stimuli for the braille reader concentrates the attention of the individual upon the immediate information (the specific one or two words immediately under the fingertips). In contrast, the print reader not only sees a wider area of information as it appears on the page, but also scans material more readily, as well as regresses and progresses instantaneously, increasing the distracting elements from the immediate information. A second type of distraction for the print reader is the variety of ongoing visual stimuli in the immediate environment. One might speculate that this could partially explain the higher mean score of the braille reading group.

An additional, and possibly more plausible, explanation might involve the operant contingencies in effect for braille readers. Primarily, this reading method is much slower, making the initial contact time-valuable. The response effort required for rereading, as well as in relocating essential information, is excessive when compared to the print-reading method. A cautious analysis of the behavioral principles in effect for braille readers suggests that punishment contingencies exist for careless initial reading, when one is unable to recall or retain needed information upon demand. This sets up an avoidance conditioning paradigm; shaping improved attending, which may increase the duration of the initial contact. Consequently, a substantial difference in the reading mean scores of the two groups was obtained. While the nature of this explanation appears to be logical, in non-laboratory situations, it is impossible to identify or assess the myriad of variables as they concurrently interact.

Tuttle (1972), in one of the very few investigations into the most effective media for the blind, found that braille reading was the most exact method. As the rate of the message increased, less information was retained. When the emphasis is on the importance of learning and retaining information, as in academic programs, Tuttle's findings, supported by present research, would appear to mandate at least two actions. (a) Materials, especially those which are complex in nature, should be constructed and provided in braille to blind students in programs of higher education. (b) Further research efforts should be conducted to categorize types of information, and determine which types of material are most crucial to the braille user.

Overall, this research supported Moffat's claim (Walker, 1976) that there is a general process of comprehension which applies equally to both reading and listening. That is, those subjects who obtained high scores in reading, also obtained high scores in listening. Those scoring low in reading also scored low in listening. In previous studies, the subjects were classified as high-skilled and low-skilled readers, or average, above average, and below average intelligence (Berger & Perfetti, 1977; Fronk, 1975; Perfetti & Goldman, 1976; Smiley et al., 1977). In the present study, subjects had reached graduate level and professional status; yet, they still demonstrated a wide range of individual differences (see Figure 1). Since these differences have been observed by researchers through all age groups and educational levels, it would be a grave error to attribute them to an organismic deficit or excess, hypothetical construct such as IQ, some fixed internal mental state or metaphorical quality, as it has been explained by traditional learning experts and other laymen. A look at the reinforcement histories of individuals, as they relate to the systematic learning process, would likely provide more pertinent information about the existing modal preferences and efficacy.

REFERENCE NOTE

Note 1. Bennet, R. Personal Communication, November 2, 1981.

APPENDICES

APPENDIX A

SECTION 1

(This material has been compiled from excerpts of a lecture presented by Dr. Milton Altar, Chairman, Department of Neurology, Temple University Medical School, Philadelphia.)

My work, the research work, involves travel. Epidemiology concerns itself with how disease appears in different populations. When I get the call, my bags are always packed, I'm off into the field like an archaeologist going on digs.

I go to different parts of the world to study what Multiple Sclerosis does to people in those areas. We think that by comparing the disease process in different areas, we might get some idea as to what causes it and how to prevent it. Maybe even how to cure it for those who already have it.

Unfortunately, I have been through a lot of good treatments and they are good for a year or two and then we say, "Gee, they are not as good as they seem to have been." So, we are a little sanguine. We are a little careful about being overly enthusiastic; but there is stuff coming out, it looks very hopeful and we--and our experience with the Plasmapheresis treatment has been very good. We'll talk more about that later.

I was completing my internship in medicine at the University of Minnesota. As luck would have it, my number came up negative in the draft and I had to report to Greenland for the Air Force. "My God!

What an I going to do with healthy Air Force people and their families? They're nice people, but," I said, "I don't want to do that."

I went crying to my chief, Abie Baker, and said, "Dr. Baker, isn't there anything that I can do in neurology?"

He said, "Yyesss-yyesss, you can do something. You can go down to the National Institute of Health and do epidemiology." He continued, "You can go down to the National Institute of Health and join Leonard Curlan and do epidemiology."

I said, "Epi--what?"

He said, "Epidemiology."

I asked, "Doesn't that have something to do with cesspools and sewage and things?"

He said, "I don't know. Go down there. He called me up last week. He says he has an opening. Go down there."

As luck would have it, Leonard Curlan was doing research on Multiple Sclerosis. He looked at me and said, "You know anything about MS?"

I said, "Yah, I know quite a bit about it."

He started asking me questions. Sure enough, I knew something about it. So he said, "Okay, you're hired. I want you to go around the world and study MS." Because Leonard Curlan was the father of Neuroephidemiology; that is, he studied neurological diseases. There were not too many people studying the epidemiology of neurological diseases.

If we were to show a slide of MS, what it looks like, it's almost like measles of the central nervous system. Looking at the cerebellum--it is the balance center of the brain; the brain stem connects the spinal chord to the brain. If we could see white spots, those are the areas of demyelination. The black areas are the fatty insulating sheaths around the nerves. The area which has lost its myelin is demyelinated. It has a plaque of MS. If we could see how spotted it is, this poor individual has many plaques of the disease and probably had a lot of symptoms from the disorder.

The disease either attacks the myelin sheath or a cell in the central nervous system (CNS) that makes myelin. The cell is called an alegocyte. It has a longer name; it's called an alegodendro gliacyte. You have to go three years in neurology to learn that word.

That's an alegodendro gliacyte and it makes myelin. This single cell serves several nerves. You could see several legs. Every leg goes out and wraps itself around a nerve. Suppose you had a disease that is going to kill this cell; you will get a patch of demyelination. So, some people say, "No, the disease is not of myelin, but of this cell." Those are the two theories which the scientists are investigating today.

Now, it takes an electron microscope, a fancy piece of equipment, to magnify thousands and thousands of times so that you can see the nerve and the myelin sheath. Where the disease attacks, the area is light. It's not shown in the dark areas, but only in the light areas. It's attacked by cells which eat it up and you get a plaque of demyelination. The nerve loses its insulation, and those of you who do electrical work know that if insulation is gone you are going to get a short circuit and the nerve is not going to conduct well. That's why people with MS do have attacks and they get worse! But then they immediately get better. When the attack is over, the nerve cell will conduct because the cell itself is not damaged until very late, if at all. The rate of conduction is slowed, and the damaged insulating sheath will not permit the nerve to conduct very fast. As a result, the individual gets a fever, takes a hot bath, gets emotionally upset, and does anything to alter the rate of conduction, simply because there is a lack of insulation and the nerve will not conduct at a normal rate. The individual will have symptoms. When he starts to feel better again, that attack will subside because, by repeating, the nerve cell is not destroyed.

How do you diagnose this thing? One of the techniques which works occasionally is the C.T. Scanner. If you do a C.T. Scan on a patient, you don't hurt him or her at all. It's like a chest X-ray and it will show either an area of rarefaction near the ventricle, which is a hollow area of the brain and it's normal; or right next to it is another area that should be dark, but it's kind of light. If you give the patient a dye which shows up under the X-ray, that area will "light up". It enhances. That is why it's called C.T. Scan Enhancement. That's an area of demyelination. It's next to this hollow ventricle. When you see it you say, "Well, the patient probably has a flare-up of MS." If you treat the patient with steroids, frequently that area will become quiet. It loses its staining properties. We can see the disease now with modern techniques while the patient is still alive and often make the diagnosis.

Also, we go to the spinal fluid, very often, for a diagnosis. We look at Gamma Globulin. That's a protein in the spinal fluid. Albumin is like eggwhites. This one is different; it is globulin and its subtype is called gamma. This gamma globulin is up; it's elevated in about two-thirds of the patients with the disease. There are very few other diseases in which it is elevated. In other CNS diseases, for example, it is only up about seven percent. So, that's a pretty useful test if you want to make a diagnosis in a living patient.

A better test is to take a little drop of spinal fluid and put it on a plate and run an electric current across it. The protein will separate because it carries an electrical charge and if you look at this area, you'll see the gamma globulin area. And in MS, you'll have bands in about seventy to ninety percent of the people. That is, between seventy and ninety percent of the people will have those bands. They're called Alegoclonal Bands. Here's a patient with syphillis who doesn't have the bands. All of these patients with MS, on the other hand, do. When you see the bands, it's called a Positive Band Pattern. That's evidence that the patient probably has Multiple Sclerosis. We don't know why they have this. We think it's reaction to some agent, but we have not identified what the agent is. We do know that it produces these alegoclonal bands.

Now for a little more about Multiple Sclerosis. Notice the age pattern. This is not even published tey; I'm giving you stuff that's not even in the medical literature yet. This fellow plotted out the pattern, the age pattern of the disease. He found that most often it begins in the thirties. This surprised us; we thought that it began a bit earlier. That's universally true, wherever the disease has been studiedin populations, the average age of onset is thirty-one. It is a disease of young adults. It hits them in the prime of their life. It affects individuals and makes them less capable than they otherwise would be; but, thank goodness, it is associated with an excellent survival rate. People do not die of MS. It's a chronic disease but is certainly not a fatal disease.

APPENDIX B

SECTION 2

(This material has been compiled from excerpts of a lecture presented by Dr. Milton Altar, Chairman, Department of Neurology, Temple University Medical School, Philadelphia.)

Now, about the epidemiology of Multiple Sclerosis. If we look at the entire United States and Canada through the lens of a satellite, we will notice a most peculiar fact about MS. That fact is that it doesn't occur everywhere. In the whole southern part of the United States, MS is rare. MS is occurring in the northern part; yes, even in Michigan. It falls in the high risk zone here and in Canada. MS is a northern disease. If we plot it out in Europe you'll find the same thing. MS occurs up here in the north and it gets progressively rarer as you go south. In South Africa, you have hardly any cases at all. You have five or six cases per one-hundred-thousand people. Whereas up here in the far north, you have three hundred cases per one-hundred-thousand people.

Why? Why should a disease like this have this unusual distribution? Well, we looked for patterns of other diseases and we were struck with the fact that polio, which wedon't have anymore since there is a vaccination for it, had a similar pattern.

As you get further north, the disease increases rapidly in frequency. How much more common is it in Rochester than in Mexico City? What is it in their latitude that influences the disease? In the southern hemisphere, Australia and New Zealand, so called Austral-Asia, the same pattern exists. As you go further away from the equator, this time toward the south, you get more and more MS.

I got my orders to go to Israel to study MS. The reason I was sent there, sent there by Leonard Curlan, was because Israel has people who had come there from northern places and southern places, and they were all being treated by the same doctors. Now, there was the question--about the doctors' training. What about Mexico City, who trained them down there? Maybe they were just missing the cases. But, you couldn't say that about Israel; it's the same doctors seeing the patients.

Now you ask, "Does everybody get it?" I have to say, you known, when we went around the world, not everybody is susceptible to MS. MS is very rare throughout the Orient. Mongolian people are resistent to MS. What about Blacks? They are also resistent to MS. Certainly, when compared to Whites, MS is a white man's burden; or more correctly, a white woman's burden. It's a disease that's about one and a half to two times more common in women than in men. Why? Well, we know that autoimmune diseases occur more commonly in females and we think it's a disease that has something to do with immunity.

What happens if people move from one place to another place; if they are, in particular, migrants? People who have come to South Africa from Britain and the United Kingdom had forty cases per one-hundred-thousand people. If they came from Central and Northern Europe, forty-eight cases per one-hundred-thousand is the ratio. These are high-ratio areas of Multiple Sclerosis. When they came to South Africa, they carried with them the high risk of the disease.

In other words, the migrants carried with them the risk of their original country.

We asked them another question, "Suppose they came as children?" Suppose they had come to South Africa as kids. So, an analysis was made and it was discovered that those who came as children had low rates, but those who came as adolescents after the age of fifteen had high rates. We had to modify our conclusions. It was true that MS in migrants was like that of their home country, unless they came as kids. If they came as children, they acquired the low rates of South Africa. They left something in the home country that caused the disease and they came to the place where they were protected from the disease.

We started asking, "What happens to people when they move?" Israel, I told you, is a country of migrants. We looked at every single age-period there. In almost every single age, the Afro-Asians had less MS than the Europeans. Then, what happens when these people have children born in Israel? There we see a change. The Afro-Asians now became like the Europeans. The people who live in Israel have MS rates like Europeans.

What's the different? Well, the diet is different. Here's how people look in Africa--empty bowls. They don't eat very well. Here's how people eat in Michigan--what you ate last night or tonight--a big turkey dinner! Grandma served it! This suggests that the way we eat influences our risk of getting MS.

I want to show you another peculiarity. In Europe, MS is concentrated here, and then waht we have right next door is the literacy rate. These are the number of people in a population who read and write, literate people. And here, it's about 99%. Do you mean to tell me that reading books causes MS? Here are AGCT scores. Those of you in the military may remember you had to take an intelligence test. Notice the rate of MS in relation to the ACGT scores, to the intelligence test scores. The most literate people had the most MS. This suggests that MS strikes the higher strata of society.

One obvious thing is sunlight. Sunlight differs with latitude. We can see a fantastic negative correlation. As the amount of sunlight drops, the amount of MS increases. That is called a negative correlation. It means, the more sunlight, the less MS; the less sunlight, the more MS.

Another thing is pollution. I'm talking about water pollution. We wanted to go to Hawaii because it was reputed to have a low rate of MS. When I was there I found this in the newspaper; they said, "Hawaii did not establish clean water standards until 1967." Until this day, if my information is correct, Hawaii still does not chlorinate its water. That was in line with out view that poor water sanitation and diseases of the gastro-intestinal tract are common where MS is rare. The area where MS is up is the area where you don't have dysentary deaths. This area where you have clean standards for water, less dysentary, you do have MS. Almost, as if from the point of view of MS, it's better to be dirty; and it's better to have polluted water.

Now to tie all this stuff together. You may be awfully confused by now, with all of these possibilities. The latest stuff shows that one of the things that happens before a flare-up of MS is that the body's immunity changes. You have white blood cells in your body responsible for maintaing immunity. Today we know that you can divide the white blookd cells into two types. They are called T-cells and B-cells. "T" stands for the thymus gland and "B" stands for bone marrow. This is indicating where those cells came from. We know that before a flare-up of MS, one of the populations of T-cells, and there are a lot of different kinds of T-cells--one of them called a T-suppressor, drops. You have less of them in your system. What is their function? These suppressor cells prevent the body from attacking itself; they block the reaction. Before a flare-up of MS, the suppressors drop. We think that the killer-T's are then free to attack the myelin. We don't know what causes the T-cells to drop, the suppressor-T's to drop, and what causes the killer-T's to increase. That's one of the mysteries. That's where we are today and we would like to study it.

The plasmapheresis, what I mentioned earlier, changes the body's immunity. We think it removes from the circulation some factor that is suppressing the T-suppressors. The plasmapheresis, then, prevents more attacks.

We even know one more fact. We know that not everybody in the population is susceptible to this reaction. Regardless of when he encounters infections, the risk is associated with a genetic ability to react in a certain way. There are a lot of individual differences. The ability to respond to infection in a certain way is genetically determined. I'll even mention the name of it; it's called the HLA system. Certain HLA types are more likely to get MS than others; that is, they are more likely to react to infections in such a way that the immune system can cause demyelination. Now, maybe next year we'll have the answer.

APPENDIX C

QUESTIONS: SECTION I

1. What was the man's name who presented this lecture and what was his title or position?
2. What is the name of the university where he is currently working and the name of the city in which it is located?
3. How does this lecturer define epidemiology?
4. What three things does he hope to gain for Multiple Sclerosis victims by comparing the disease process in different areas?
5. He refers to a new treatment for which he cautiously holds out hope. What is the name of this treatment?
6. What was the lecturer's original mistaken notion about what epidemiology is concerned with?
7. What particular field of study was Leonard Curlan the father of?
8. If we were to look at Multiple Sclerosis as it could be represented on a slide projection, what analogous comparison could we make in terms of what it looks like?
9. What were the white spots denoting?
10. What would the black area be representing?
11. What was the technical name given to the cell in the central nervous system that make myelin?
12. What is the name of the piece of technical equipment required to produce sufficient magnification to make these observations?
13. What is myelin? What is its function in serving the nerve?

14. What is the effect of Multiple Sclerosis on the rate of conduction of nerve impulses?
15. As a rule, what is the situation as it relates to damage to the nerve cell itself?
16. What is the name of the diagnostic test for Multiple Sclerosis which somewhat resembles the process of the chest X-ray?
17. If you were to give a MS patient a dye which shows up on an X-ray, the affected area lights up. What is this area likely to be denoting?
18. What is the name of the results of this process?
19. Another diagnostic assessment, using the spinal fluid, finds one of the protein subtypes elevated in about two-thirds of the patients with the disease. What is this protein subtype?
20. The lecturer describes another procedure for making a diagnosis which he says is a better test. What substance does this procedure use to produce positive band patterns in MS patients?
21. What are these bands called?
22. What surprising fact was uncovered in the data generated by the age patter of Multiple Sclerosis victims?
23. What was the scientists' original contention concerning this fact?
24. What was the average age of onset that was found to be universally true?

APPENDIX D

QUESTIONS: SECTION II

1. Considering the United States, in which geographic location do we find Multiple Sclerosis rarely occurring?
2. What is the situation concerning risk in Michigan?
3. How many cases per one-hundred-thousand people do you find in South Africa?
4. What extremity was observed to occur in cases per one-hundred-thousand people in the far north?
5. What was the name of the disease that followed a similar pattern of distribution of MS?
6. What was the confounding question the scientists were considering about the doctors and their identification of cases of MS?
7. What geographic location was considered to be a good control for this confounding variable? Why?
8. The lecturer mentioned two racial groups who appear to be highly resistant to MS. Which groups were they?
9. Multiple Sclerosis is found to be more prevalent in one sex than in another. Which sex contracts the disease more often? What is the ratio?
10. What was the frequency of occurrence of MS per one-hundred-thousand people in Britain, the United Kingdom, and in Central and Northern Europe?

11. What happened to the risk factor for getting MS in the adult populations of Britain and Northern Europe when they migrated to South Africa?

12. What modifications to their conclusions did the researchers find it necessary to make concerning the migrants to South Africa?

13. What was significant about diet?

14. The lecturer somewhat jokingly discussed two variables which were found to have a high correlation with MS incidence. He says that this is suggesting that MS strikes the higher strata of society. What were these two variables or correlates?

15. What was the obvious difference when looking at latitude on the influence of incidence of MS? What is this type of correlation called?

16. In looking at water pollution as one of the correlates, what surprising information was disclosed about Hawaii?

17. A correlation which would appear similar to the type which was generated when observing latitude variables is between MS occurrence and the incidence of another disease with concurrent water conditions. What was the other disease and the condition of the water?

18. What is the major responsibility of the white blood cells in the body?

19. The white blood cells are divided into two types. What are these two types? What systems are responsible for producing these two types of cells?

20. What is the name of the subtype of one of these particular cells which is found to be low or decreased in Multiple Sclerosis patients?

21. What is the function of this cell in the body's normal immunity reaction process?

22. What is the name of the recent treatment which holds out hope for the improvement of MS patients?

23. What determines an individual's ability to respond to infections?

24. What is the name of the system that responds to infections?

APPENDIX E

ANSWER KEY

SECTION I

1. (1 pt.) Milton .25; Altar .25; Chairman .25; Neuroepidemiologist .5, neurology .25, neurologist .25, physician .,25.
2. (1 pt.) Temple .5; Philadelphia .5.
3. (1 pt.) Epidemiology concerns itself with how disease appears in different populations 1, disease process in different areas 1 (necessary elements: disease, populations, cultures, varying).
4. (3 pts.) causes 1; prevention 1; cure 1.
5. (3 pts.) plasmapheresis 3, plasma 1.5, pheresis 1.5, esis .75.
6. (1 pt) cesspools .5; sewers or sewage .5.
7. (1 pt.) neuroepidemiology 1, epidemiology .5, neurology .5.
8. (3 pts.) measles 2, white spots 1; CNS 1, brainstem .5, spinal cord 1, cerebellum .5.
9. (1 pt.) Areas of demyelination 1, areas that have lost their myeline 1, plaques .5, MS .5.
10. (2 pts.) The fatty insulating sheath around the nerve 2, fatty substance 1, insulation, covering or coating around the nerve 1, protein polysarcharides 2, healthy tissue .5, normal tissue 1.
11. (4 pts.) allegodendro gliacytes 4, allego 1, dendro 1, glia 1, cytes 1.
12. (1 pt.) electon microscope 1, microscope .5, electrically .5.

13. (3 pts.) fatty substance insulating the nerve, facilitates conduction 3, fatty substance 1, insulating coating 1, sheath 1, conduction 1.

14. (1 pt.) slows 1.

15. (1 pt.) none 1, little if any 1, little till late 1.

16. (1 pt.) C.T. Scan 1, C 1/3, T 1/3, Scan 1/3.

17. (1 pt.) areas of demyelination 1, rarefaction 1, white spots .5, flare-up .5, MS .5.

18. (1 pt.) C.T. Scan Enhancement 1, enhancement 1, contrast .5.

19. (2 pts.) gamma 1; globulin 1.

20. (2 pts.) spinal fluid 2, spinal 1, fluid 1, electropheresis 1.

21. (3 pts.) allego 1.5, clonal 1.5.

22. (1 pt.) begins in the thirties 1, later than believed 1.

23. (1 pt.) thought it had begun earlier 1.

24. (1 pt.) 31 1.

APPENDIX F

ANSWER KEY

SECTION II

1. (.5 pts.) South .5.
2. (.5 pts.) high or high risk .5.
3. (1 pt.) five or six 1, five .5, six .5.
4. (1 pt.) 300 1.
5. (.5 pts.) polio .5.
6. (2 pts.) about their training or where were they trained 1, quality of doctor .5, were they missing the cases 1.
7. (3 pts.) Israel 1, people came from north and south 1, treated by the same doctors 1.
8. (1 pt.) Mongolians ,5, Orientals .5, Blacks .5.
9. (1 pt.) females .5, ratio of one and one-half to two times as often .5, 1.5 times as often .25, 2 times as often .25.
10. (1 pt.) forty .5, forty-eight .5.
11. (1 pt.) They carried with them the risk of their original country 1, stayed the same 1.
12. (2 pts.) If they came as children, they acquired the new low rates of the South Africans 2, came as children, it changed 1, acquired low rates of South Africa 1, before age 15, or before adolescence, it changed 1.
13. (.5 pts.) The way we eat influences our risk of getting MS .5, more food, more MS .5, less food, less MS .5.

14. (2 pts.) literacy rate 1, ACGT scores 1, intelligence test scores 1, intelligence .5.

15. (2 pts.) sunlight 1, negative correlation .5.

16. (2 pts.) didn't establish clean water standards till 1967 1, still doesn't chlorinate its water 1.

17. (2 pts.) dysentary death rates 1, poor water sanitation 1, polluted water 1.

18. (2 pts.) maintain immunity 2.

19. (4 pts.) T-cells 1, B-cells 1, thymus gland 1, bone marrow 1.

20. (2 pts.) T-suppresor cells 2, T 1, suppressor 1.

21. (2 pts.) they prevent the body from attacking itself 2, they block that reaction 2, suppress killer white cells 2, prevent autoimmune responses 2.

22. (3 pts.) plasmapheresis 3, plasma 1.5, pheresis 1.5, esis .75.

23. (1 pt.) genetics or genetically determined 1.

24. (3 pts.) the HLA system 3, H 1, L 1, A 1.

APPENDIX G

INSTRUCTION TAPE

Please read and listen to, very carefully, the entire contents of this material--just one time. Following this, you'll be asekd to respond to a set of questions which parallel the section you have just completed. When possible, please respond with your answer in the same word or words which were used in the text, as closely as you can remember. In most cases, you can respond with one or two words. Some questions will require a short sentence answer. When you feel uncertain about your answer, write down what you think you recall it to be. Also, do the same when you remember only part of the answer. In other words, it always will be better to approximate or be partially correct, than to leave it blank.

This study is designed for the purpose of making a comparative analysis of the modalities; not to test or reflect the individual's specific abilities.

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