Assessment of Learning Disabilities Among a Pharmacy Student Population[1]

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American Association of Colleges of Pharmacy GAPS funding provided support to screen 214 pharmacy students enrolled in a Doctor of Pharmacy Program for dyslexia and other learning disabilities. The results have substantial implications for teaching, testing, and student performance in schools of pharmacy. In its simplest definition, dyslexia is "word difficulty." Recent studies indicate that this condition can also involve numbers and symbols, as well as words and letters. This study was designed to detect dyslexia as well as other learning disabilities included under the term "information processing variations." It seems logical that not all individuals receive, process, send, or recall information in the same way or with the same speed, yet our educational methods tend to expect and demand this of students. Learning disabilities have been reported to occur with varying degrees and with varying compensatory mechanisms in approximately 15 percent of all children in the United States. Results from our preliminary study utilizing a broad assessment corroborated these findings among pharmacy students. The student's individual performance on each visual and auditory test was ranked among all students from lowest to highest. Statistical analysis of all objective tests was completed using SPSS for Windows (release 6.0). Extreme values (widely variant) were recorded for individual tests. Thirty-four students (15.9 percent) of the 214 tested had one or more test scores in the "extreme" value range. Studies at the New York University College of Dentistry also have found a similar frequency of occurrence among their professional student population further supporting the value and necessity of assessing health profession students for learning disabilities.

INTRODUCTION

Anecdotal support for the relevance and utility of the methods being applied can be inferred from the following individual case which arose in our trial study.

> A third year student had a cumulative GPA of about 2.0 on a 4.0 system and was on academic probation. After the first exams in four courses during the first semester of the third professional year, all of this student's scores were in the 50 to 60 percent range. The disability screen indicated strong auditory skills, but poor visual memory abilities. The student was given the opportunity to take subsequent exams in a room where he could read each exam aloud. Exam scores in all four classes increased into the 70 to 80 percent range. By the end of the semester all of the student's grades were in the C-range which was a marked improvement from the beginning of the semester. The student's subsequent performance in clerkship activities was above average.

A singular definition of the term "dyslexia" has been difficult to achieve(2). However, there is agreement about the vast individual differences that are possible in visual perception and processing, fine motor function, and auditory perception and processing among students(3,4). In its simplest definition, dyslexia is "word blindness"(5). Recent studies indicate that this condition can also involve numbers and symbols, as well as words and letters(6,7). This study was designed to detect "dyslexia" as well as other learning disabilities that are directly related to how individuals process information. There are numerous other learning mechanism disabilities in addition to dyslexia(8).

Learning disabilities in reading, spelling, and arithmetic occur with varying degrees and with varying compensatory mechanisms in approximately 15 percent of all children in the United States(9). Results from our preliminary study corroborated this incidence among pharmacy students(10). Parallel studies at the New York University (NYU) College of Dentistry also have found similar frequencies in their student population[2-4]. The number of learning disabled students entering college has grown dramatically over the last decade and this growth

[1]Supported by a Grant Award for Pharmacy Schools (GAPS) grant from the SmithKline Beecham Foundation through the Amercian Association of Colleges of Pharmacy.

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may reasonably be expected to continue(11,12). The legal implications and obligations defined by the Americans with Disabilities Act as they apply to medical education have been described in some detail(13-15). Our studies reported herein support the fact that not all individuals receive, process, send or recall information in the same way or with the same speed, yet our academic environment tends to demand this of students.

METHODS AND PROCEDURES

Screening Instrument. The two-hour screening instrument was developed by the collaborative efforts of many individuals. Drake, then a graduate student at Harvard University, developed the initial screening tool as part of his doctoral dissertation.[4] After completing his doctoral studies he started a private school for the learning disabled, now LANDMARK College and LANDMARK Schools. One portion of the screening instrument, Berea, is a modification of an exam (Gestalt) used during World War II in the testing of individuals for officer candidacy(16,17). Other portions of the screening battery are widely utilized, unfortunately the documentation of their validity comes from unpublished studies. Portions of the screening instrument are extensively employed in the LANDMARK Schools programs.

Approximately 13 years ago, Antanoff, Parks and Drake further modified the screening instrument for administration to dental students. After careful statistical analysis and practical experience the instrument was slightly modified several times during the first seven years of use. The instrument utilized for pharmacy students is the same battery of tests which has been used in the dental school population for the past five years.[2-4]

The absolute validity of the screening instrument has not been determined since this would require a significant expenditure of funds. Definitive testing requires 8-12 hours of testing and usually costs between $500 and $1,000 for each individual. To assess the varying degrees and other types of learning disabilities, and control other confounding factors in a comprehensive study would be cost prohibitive. But, examining the incidence of occurrence among small student groups, as reported in this study, is critical to supporting future validation studies. Practically speaking, validation of the testing methodology has not been a problem for the N.Y.U. Dental School. The academic progress of those who screen positive for a learning disability becomes another helpful factor along with the detailed history sheet. Individuals with poor academic performance coupled with suspect screening results are strongly encouraged to seek definitive testing.

The screening battery was comprised of the tests (Figure 1) to detect the indicated differences and preferences among learning skills for an individual. The screening battery assessed visual, auditory, motor and memory skills; coding or new task learning; spelling, writing and mathematical abilities. Naturally, when students have deficiencies in these areas, they will learn (perform) best if the teaching and testing methods compensate for their individual strengths and weaknesses. When results were discussed with individuals who screened in the extreme range, many students had self-perceived problems, but they were largely unable to correctly identify their own strengths and weaknesses.

Berea Visual Motor	**Visual-perceptual motor functioning (BC)**
Gestalt (BC and BM)	**Short-term visual memory (BM)**
Paragraph copy Handwriting (PC)	**Speed and accuracy of copying a paragraph**
Coding (CO)	**Speed and efficiency in paper and pencil tasks memorization of symbols**
Auditory Memory for Unrelated Words	**Non-sequential auditory memory**
Arithmetic Coding (AC)	**Memorization and manipulation of symbols**
Visual Memory (VM)	**Visual memorization of words**
Spelling (SP)	**Spelling words from phonetic representation**
Scanning Total (ST)	**Atomization process**
New Coding (NC)	**Speed and efficiency of task memorization**

Fig.1. Test battery for learning disabilities.

Individuals with strong visual memory skills tend to recall symbolic material and can easily reproduce the symbols. These skills become very helpful for copying information from the board or overhead projection. Visual memory skills are also required to recall and reproduce information that is observed from a graph or instrument (*e.g.*, microscope, EKG, MRI, etc). Strong visual skills are usually associated with a high ability to spell correctly.

Deficiencies in the motor system may result in similar outward deficiencies as the visual memory skills, that is, poor note-taking abilities and difficulty in copying information from the board or visual projection, but remediation is drastically different for the two conditions. Individuals with poor visual memory skills tend to compensate with their auditory system. These individuals may develop an amazing ability to remember what they hear. While both groups often need assistance with note taking, tape recording and re-hearing these activities will benefit individuals with poor visual memory skills. However, individuals with inadequate motor systems are less likely to be assisted with taping or re-hearing lectures, and in fact, this approach may be a waste of study time. These students might benefit from eyeglasses, changing classroom seating position, or assisted note-taking.

In general, deficiencies in visual perception will require multisensory approaches to learning: combining auditory, visual and tactile-kinesthetic modes. In courses like anatomy, where names and relationships between body parts must be learned, students might learn best if they could handle (tactile-kinesthetic) anatomical models [in addition to simply viewing them]. These students may further enhance their learning by developing cognitive approaches for remembering diagrams by verbalizing (reading aloud) a description of the details to be learned; and by placing information on flash cards for continuous repetition and review.

Individuals with strong auditory perception tend to be very good with learning new names, have strong vocabularies, and find foreign languages fairly easy to master. Individuals with weak auditory skills tend to have to learn terms and names very deliberately. Verbal concepts must make sense, or must be presented very logically. Simply

Table I. Summary of pharmacy student performance scores

	Mean	SD	Median	Mode	Range
Berea copy	11.59	3.65	12.0	12.0	2-20
Berea memory	11.59	3.64	12.0	12.0	2-20
Paragraph copy	50.85	8.17	49.0	49.0	37-75
Coding	68.16	11.0	68.5	64.0	42-90
Auditory memory	55.27	5.37	56.0	61.0	37-65
Addition coding	51.06	10.52	51.0	45.0	22-83
Visual memory	54.93	5.94	55.0	55.0	37-76
Spelling	36.03	9.24	38.0	41.0	10-54
Scanning total	103.84	14.0	106.0	106.0	62-128
New coding	70.80	11.3	70.0	69.0	36-107
Total score	524.46	49.6	539	478	345-659

Table II. Remedial techniques for common learning disabilities

Identified weakness	Useful compensatory remediation
Visual Perception	Auditory reinforcement (loudspeaker; hearing aid; audiotape repetition; tactile models; flash cards)
Visual Memory	Visual reinforcement (notetaker assistance; instructor-written summary; textbook re-reading; oral or read aloud exams)
Physical Motor Skills	Alternate methods (classroom seating; eyeglases; notetaker assistance; computer word/speech processing; handwriting exercises)
Auditory Perception	Visual reinforcement methods (see above)
Auditory Memory	Visual reinforcement
Symbol Recognition	Use of hands-on three-dimensional models and participatory learning methods (*e.g.*, small group discussions; clerkships)
Number Recognition	"Talking" calculator; hands-on laboratory (*e.g.*, weighing and measuring; pill-counting; syringe handling)
Graph Analysis Deficiency	Require student to copy and re-draw graphs; color differentiation of variables in graphs; duplicate presentations (*e.g.*, pie chart and bar graph); enlarged or exaggerated scale graphs

verbalizing a list of facts is likely to result in frustration. Dictation would be extremely difficult for these individuals. Course outlines, overhead projections, slides and supplemental readings will be very beneficial to the individuals in the weak auditory group.

The tests in the screening battery that require coding are related to a student's ability to learn new tasks. Students with learning disabilities tend to learn new tasks more slowly than the "average" student. Students with poor results in the coding sections are most likely to be the last students in the exam room. These students are likely to require much more time to start answering essay questions. Multiple choice type questions may be particularly time-consuming for these students. Studies have demonstrated that time extension is not likely to improve scores for the average student, but additional time almost always helps the learning disabled student(18). Remediation for students scoring low in this area is to allow them to slow down on exams, because many times they run out of time, so they feel they must hurry, which only exacerbates the problem. All the national testing agencies that administer exams (*e.g.*, SAT, ACT, PCAT and NAPLEX) provide extra time to individuals who have an appropriately documented learning disability.

Summary of Procedure. The test battery was administered to 214 Campbell University entry-level PharmD students on one day by Dr. Stanley Antanoff. He also provided training so that the investigators could administer future tests. The student population consisted of 72 first professional year students, 68 second professional year students, and 74 third professional year students; no final year students were included as they were involved in off-campus clerkship activities. Most of the tests were graded and scored by the investigators; one of the visual memory and visual copy tests along with the writing sample was analyzed by an independent educational psychologist. A two-page detailed individual history was collected which included questions like: "Did you ever repeat or skip a grade in school?" "Which subjects are particularly difficult or easy for you?" and a self-assessment of strengths and weaknesses. Each student history was also sent to the psychologist.

RESULTS

The results of subject testing are recorded in Table I which includes, mean, standard deviation, median, mode and range. The student's individual performance on each test was ranked among all students from lowest to highest. Statistical analysis of all objective tests was completed using SPSS for Windows (Release 6.0). Widely variant extreme values (beyond 5 standard deviations) were recorded for individual tests. Thirty-four students of the 214 tested had one or more test scores in the "extreme" value range, which represented 15.9 percent of the total. Eighteen students had 1 "extreme" value score; 10 students exhibited 2 "extreme" values; three students showed 3 "extreme" values; two students had 4 "extreme" values; and, one student scored 6 "extreme" values. The individual with 6 extreme values only has vision in one eye and English is his second language. Obviously, this case illustrates the effect of severe confounding variables. Two other students who reported that English was not their first language, had 2 and 4 "extreme" values. When English is a student's second language, the screens cannot distinguish between a language problem and a learning disability. Eleven students screened positive for visual memory problems; 11 students screened positive for motor-related problems (copying exercises); four students screened positive for auditory deficiencies and, 15 students screened positive for coding problems.

DISCUSSION

This study confirms the significant occurrence of learning disabilities among pharmacy students and provides additional validation of screening methods previously employed at the N.Y.U. dental school. Other than the three students whose first language was not English, no student screened positively for both visual and auditory memory deficiencies. This may not be surprising since a student who advances to this level of education, probably has optimized their compensating processes (*e.g.*, auditory/visual). Individual pharmacy students enrolled in each class had been selected from among 4-6 applicants to the school.

Performance results analyzed by Levene's Test for Equality of Variances and Student's *t*-test for Equality of Means revealed no dependence upon a student's year in pharmacy school (P-1, P-2 or P-3). Individuals who screened at extreme levels had varying GPA's. One P-3 student had all A's with the exception of one B; while another P-l student was in severe academic difficulty and was not likely to progress to P-2 status. The relationship between "giftedness" and "learning disabilities" among college students has been investigated recently(19).

Screening for learning disabilities can be used beneficially by universities to assist students who are experiencing academic difficulty, as well as to benefit "above average" students. As stated earlier, simple remedial techniques may significantly improve student performance. Remedial techniques might include (Table III): allowing students additional time on exams; giving students the opportunity to read their examinations out-loud; allowing students to sit at the front of the classroom; and allowing students who are weak notetakers to tape-record lectures. Automated assistive technologies are now available to compensate for learning disabilities of students in convenient and non-disruptive ways(20,21). Improving the education of learning disabled students will permit them to practice their chosen profession more effectively and will provide improved academic outcomes for the university(22,23), however, workplace accommodations which might be required may be different than those required in the classroom. Our University has chosen to work individually with students who screen positive in this battery to help them learn to compensate for their disability, thus improving student performance and lowering our attrition rate.

The dental school reports greater than a 82.9 percent accuracy rate with the screen, that is, 82.9 percent of the individuals who screen positive also test positive in definitive testing.[2,3] Through internal documentation the dental school has been able to retain a minimum of 1 to 2 students from each class who would have failed without the minor adaptations (taping lectures, more time on exams and assistance with note-taking) which were identified as necessary through screening and definitive testing. Disability testing has bolstered revenue in the N.Y.U. dental school by four to six student tuitions each year. This may partially explain the continued administrative financial commitment to this testing program and the creation of a part-time coordinator position for the learning disabilities program at N.Y.U. Such an approach might be appropriate for pharmacy schools, as well, although accommodation of identified learning disabilities among students may also increase costs of education for these students.

Am. J. Pharm. Educ., **63**, 68-72(1999); received 7/22/98, accepted 12/15/98.

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