

**THE INFLUENCE OF DIMETHYLAMINOETHANOL (DEANER)
ON THE PSYCHOMETRIC INTELLIGENCE OF
RETARDED CHILDREN**

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CURRICULUM STUDIORUM

Richard T. Paton was born September 28, 1938, in Montreal, Quebec. He received the Bachelor of Arts degree, with a major in Psychology, from Carleton University, Ottawa, in 1960.

TABLE OF CONTENTS

Chapter	page
INTRODUCTION	vi
I.- REVIEW OF THE LITERATURE	1
1. The Psychopharmacology of <u>Deaner</u>	1
2. Theoretical Considerations	8
3. Previous Studies in the Field of Intelligence	12
4. Summary and Statement of Hypothesis	23
II.- EXPERIMENTAL DESIGN.	25
1. The Tools of the Experiment	25
2. Selection of the Sample	29
3. The Experimental Procedure	35
4. Statistical Evaluation	42
III.- RESULTS AND DISCUSSION	45
1. The Basic Results	45
2. An Examination of the Subtests	55
3. Observed Behavioural Changes	61
4. Summary of Results	66
SUMMARY AND CONCLUSIONS.	67
BIBLIOGRAPHY	70
 Appendix	
1. A SAMPLING OF THE RAW DATA	74
2. A NEWSPAPER CLIPPING	78
3. ABSTRACT OF <u>The Influence of Dimethylaminoethanol (Deaner) On The Psychometric Intelligence of Retarded Children.</u>	79

LIST OF TABLES

Table	page
I.- Preliminary Statistics on Matched Groups.	34
II.- Results of Total Groups After Drug Administration.	48
III.- Results of Mongoloid Groups After Drug Administration.	49
IV.- Results of Cultural Familial Groups After Drug Administration	53
V.- Mean Number of <u>Stanford-Binet</u> Items Passes.	57
VI.- Number of Subjects Reported Improved as a Result of Drug Treatment.	64
VII.- The Mongoloid Experimental Group.	74
VIII.- The Cultural Familial Experimental Group.	75
IX.- The Mongoloid Control Group	76
X.- The Cultural Familial Control Group	77

INTRODUCTION

For many years, researchers in Psychology and other related fields have been trying to improve intelligence with the use of chemical agents. Hundreds of studies have been conducted with Glutamic acid, and several with various different vitamin compounds. Many of these studies have shown encouraging positive results, but many have also demonstrated no positive correlations, between chemical agents and increases in intelligence. With the advent of the new "wonder drugs", further studies in this field have been conducted, and with essentially the same conflicting results. When a relatively new psychotropic agent (Deaner) was introduced in 1958, this problem again presented itself. In spite of the claims that had been made for this new product, very few well controlled studies have been conducted up to the present time. The few studies which have been carried out, in an effort to study the relationship between Deaner and psychometric intelligence, were pitifully weak in their controls and general methodology. Once again, science was faced with the problem of conflicting results, and the question: Does Deaner increase I.Q.? was still not adequately answered. It was important, therefore, to conduct a well controlled study in this field to determine conclusively what effects Deaner does have on psychometric

intelligence. It is to this end that the present study has been directed.

At the outset, this report deals with the previous studies which have been conducted in the field of intelligence. Their conflicting results and sometimes inadequate controls are illustrated, and the need for further research is pointed out. This is followed by a formulation of the experimental hypothesis at the conclusion of chapter one.

In chapter two, the experimental and statistical procedures of the research are presented, and at this time a description of the tools and the sample is given.

Chapter three presents the results of the experiment, and an attempt is made to discuss the importance of the clinical findings. Psychometric subtests are more closely examined, and behavioural changes attributable to Deaner are also investigated. This leads to the Summary and Conclusions where suggestions for further research are put forward.

Appendix one supplies a sampling of the raw data where statistics on individual subjects are provided.

CHAPTER I

REVIEW OF THE LITERATURE

In this chapter, the relevant studies which have been conducted in the field of psychopharmacology and intelligence are critically reviewed, with the aim of pointing out their merits and shortcomings, and the need for further research in this area. However, before the reader can fully appreciate the significance of these previous works, as well as the present study, some knowledge of the psychic activator dimethylaminoethanol¹ is necessary.

1. The Psychopharmacology of Deaner.

The chemical agent which has been utilized in this research, and which is referred to throughout the dissertation, has been given the proprietary or trade name of Deaner by its manufacturers, the Riker Pharmaceutical Company. The non-proprietary or generic name of deanol has sometimes been used to describe this compound, and it is also referred to by its chemical name, 2-dimethylaminoethanol.

Deaner has been referred to by many descriptive titles, but it is almost universally accepted by pharmacologists and psychologists alike to fall under the broad

¹ Hereafter referred to as Deaner.

classification of Psychic Energizers. The psychic energizer, as its name implies, is purported to activate or stimulate the cerebral cortex and hence increase mental activity. As Ostow has pointed out in this regard:

The psychic energizer speeds motor and intellectual activity. It heightens responsiveness to stimuli, not by improving the function of apperception, but by increasing the readiness to respond to percepts that release instinctual behaviour.²

Other psychic energizers which may be more familiar to the reader are Iproniazid and the amphetamine group of stimulants; but in many respects Deaner appears to be superior to these agents.

In giving a general description of Deaner, Wood³ and Martin⁴ have mentioned the following facts. Deaner was introduced in 1958 as a cerebral stimulant having parasympathomimetic activity. This commercial compound is the para-acetamidobenzoate salt of 2-dimethylaminoethanol, a tertiary amine which differs from choline only by the absence of one methyl group. Studies have indicated that this

² M. Ostow, Drugs in Psychoanalysis and Psychotherapy, New York, Basic Books, 1962, p. 309-310.

³ H.C. Wood (ed.), The Dispensatory of the United States of America, 25th ed., Philadelphia, J.B. Lippincott Co., 1960, p. 52.

⁴ E.W. Martin, et al., (eds.), Remingtons Practice of Pharmacy, Easton, Pennsylvania, Mark Publishing Co., 1961, p. 1066.

compound has a mood elevating effect, and a beneficial effect on behaviour in children, by providing greater daytime energy and a better ability to concentrate. Deaner has been proposed for the symptomatic relief of a variety of vague complaints, such as chronic fatigue, neurasthenia, and neurotic depression, and for the alleviation of behaviour problems and learning difficulties in school children. The low level of toxicity experienced with this drug gives it a distinct advantage over the amphetamines mentioned above, and the only contra-indication for Deaner is in cases of Grand Mal Epilepsy, as there is a danger of increasing seizures.

The use of Deaner in the treatment of Schizophrenia and other neuropsychiatric disorders is also considered to be most promising, especially when combined with tranquilizing medication. Its stimulating effect counteracts the excessive sedation and lethargy produced by the tranquilizer, and its own anti-psychotic effect is additive to that of the tranquilizer.⁵

With the above description of this psychic energizer in mind, it is now necessary to discuss briefly the rationale behind Deaner's proposed effectiveness.

5 H. Beckman (ed.), The Year Book of Drug Therapy, Chicago, The Year Book Publishers, 1960-1961, p. 381-382.

It has been established that dimethylaminoethanol is a precursor to acetylcholine, and as such is therefore a natural constituent of the body chemistry. The drug, then, acts to improve natural biochemical functions. Several authorities concur in this regard and their statements are presented here for comparison.

Lemere,⁶ in a paper presented in September 1958, points out that, "Deanol acts as a psychic energizer by promoting the formation of acetylcholine in the brain, and thereby facilitating neuron activity and the transmission of impulses".

Lemere and Lasater conjointly argue that:

Deanol is a precursor of acetylcholine which is essential to the transmission of impulses between neurons. Theoretically anything that would facilitate acetylcholine formation would stimulate the reactivity of the nervous system.⁷

In agreeing with the above quotations, Nina Toll, in addition, states that:

⁶ F. Lemere, "Pharmacologic Treatment of Depression", in Northwest Medicine, (no place), September 1958, p. 1149-1150.

⁷ F. Lemere and J.H. Lasater, "Deanol (Deaner) in the Treatment of Neurasthenia and Mild Depression", Preliminary report from the Department of Psychiatry, University of Washington School of Medicine, Seattle, Washington.

Deaner has been found to affect the electrical activity of the brain in man and animals, and to block conditioned avoidance responses. Clinically the drug has been reported to relieve mental depression and fatigue, and to stimulate learning.⁸

Since Deaner is a precursor to acetylcholine, an element found naturally in the body, it becomes easier to understand how this drug operates, and also the reason for its low toxicity and minimal undesirable side effects.

It is of grave importance, however, to discern whether or not Deaner is capable of penetrating the blood brain barrier, for if this is not the case, its effectiveness would be naturally reduced. However, many studies which have been conducted with Deaner have demonstrated that it does indeed cross the blood brain barrier and is then converted intracellularly to acetylcholine. The most widely accepted of these studies has been conducted by Pfeiffer⁹ and his co-workers. He points out that total doses, as low as ten to twenty milligrams of Deaner per day, produce in less than two weeks a mild and pleasant degree of central nervous system stimulation. This stimulation which occurs

⁸ Nina Tell, "Deaner an Adjunct for the Treatment of Schizoid and Schizophrenic Patients", in the American Journal of Psychiatry, Vol. 115, No. 4, October 1958, p. 366-367.

⁹ C.C. Pfeiffer, et al., "Stimulant Effect of 2-Dimethylaminoethanol Possible Precursor of Brain Acetylcholine", in Science, Vol. 126, No. 3274, September 1957, p. 610-611.

is not accompanied by a rise in blood pressure, a rise in body temperature, or a change in the plasma level of protein bound iodine.

Schorer¹⁰ also states that the alcoholic constituent of deanol diffuses readily through the blood brain barrier and can be converted to choline, a precursor of acetylcholine. "Hence", he points out, "it might be expected to stimulate brain function".

In summarizing the work which had been done with Deaner, Kautz¹¹ remarked that compared with choline, deanol more readily passes the blood brain barrier, and has been found to occur in the human brain in free and in bound form. He points out, however, that the reported beneficial effects of the drug on mood and behaviour remain to be confirmed by fully controlled studies in which placebos are used.

Ostow¹² and other authorities also concur in their beliefs that Deaner is indeed capable of penetrating the blood brain barrier. This information, while perhaps giving assurance that the drug is chemically active, has still not

10 C.E. Schorer and P. Lowinger, "Deanol: A Clinical Trial", in Diseases of the Nervous System, Vol. 20, No. 6, June 1959, p.

11 H.D. Kautz, "New and Nonofficial Drugs", in the Journal of the American Medical Association, Vol. 172, No. 14, April 2, 1960, p. 1518-1519.

12 Ostow, Op. Cit., p. 316-317.

adequately explained the reason for its production and addition to the armamentarium of psychic energizers and tranquilizers already being produced. This aspect dealing with the pharmacology of Deaner is now dealt with briefly.

At the outset, Barsa, in discussing tranquilizers and energizers, points out the following:

Tranquilizers achieve their tranquilizing or calming effect by lessening the force and, as a result, the fearfulness of incoming stimuli. Energizers, however, relieve anxiety by stimulating the patient and thus increasing his sense of well being and his feeling of confidence.¹³

As is well known by all, the amphetamine derivatives have long been used in psychiatry for the latter purpose mentioned above by Barsa. However, the amphetamines have also had serious drawbacks and side effects, and it is primarily for this reason that Deaner was introduced. As Moriarty¹⁴ has pointed out, "Deanol does not produce the artificial and frequently undesirable type of stimulation often true of the amphetamines". He goes on to say that the drug is superior to the usual stimulants and to a variety of tranquilizers, as its side effects even with large doses, are minimal.

¹³ J.A. Barsa, "Tranquilizers and Energizers", in the American Journal of Psychiatry, Vol. 115, No. 6, December 1958, p. 543.

¹⁴ J.C. Moriarty and J.C. Mebane, "Clinical Uses of Deanol (Deaner) A New Type of Psychotropic Drug", in the American Journal of Psychiatry, Vol. 115, No. 10, April 1959, p. 941-942.

Deaner was synthesized then, as a cerebral stimulant with a minimum of toxic side effects, designed to increase psychic energy in the majority of subjects receiving the recommended dosage. The quantity suggested by the manufacturer as a daily maintenance dosage is between twenty-five and one hundred milligrams. When administered in these quantities, this psychic activator is reputed to increase the level of concentration and attention span in the majority of patients.

From this description of the pharmacology of Deaner, it is possible to see why the drug was produced and its potential uses. This has also served as an introduction to the section of this report on theoretical considerations, where the theory of the relationship between Deaner and psychometric intelligence is discussed.

2. Theoretical Considerations.

The question of whether or not Deaner is capable of increasing the I.Q. of mentally retarded children is the chief investigation of this dissertation. Theoretically, from what is already known about the psychic energizers, one would expect a concomitant increase in measurable intelligence, after a reasonable period of drug administration.¹⁵

¹⁵ Intelligence is here operationally defined as that which the intelligence tests measure. This definition is further expanded in a later chapter, to refer more specifically to the present study.

The problem, then, is to explain a suspected increase in psychometric intelligence after the administration of Deaner.

It has already been illustrated in the previous section that Deaner does penetrate the blood brain barrier, and is therefore chemically effective. Such a reaction will cause an increase in level of concentration and attention span, and it should be possible to test this statement through actual experimental processes. On this basis, one would theoretically expect that Deaner would also increase tested intelligence, due to its effect on the brain chemistry. This possible increase in intelligence could be measured by the standard intelligence tests in use today, but in particular the Stanford-Binet (1960) Scale, as it applies specifically to this study.

By the use of such a scale as the Stanford-Binet, it is possible to measure an increase in level of concentration or attention span, as many subtests of this scale are capable of performing this function.¹⁶ It is therefore postulated that the subtests designed to measure attention span and level of concentration will show the greatest increase upon retesting, and will contribute the most to a significant

¹⁶ E.B. Breene, Measurements of Human Behaviour, New York, The Odyssey Press, 1941, p. 24.

increase in measurable intelligence, if indeed such an increase actually occurs.

The above theory is based on the fact that Deaner does increase attention span. Without this necessary prerequisite it is not likely that an increase in I.Q. would be forthcoming after the administration of this compound. However, several independent investigators have illustrated that Deaner does in fact increase level of concentration.

Oettinger¹⁷ points out that deanol accelerates mental processes and improves concentration span, and he was of the opinion that the decrease in overactivity and lengthening of attention span in his children with behaviour disorders contributed to an increased over all social adaptation and scholastic functioning. However, Oettinger does not report the extent of this increase, or its level of significance.

Fields,¹⁸ in his discussion of children with organic and functional behaviour disorders, states that with the use of Deaner, the children's attention span was increased and they obtained better grades in school. Clinically, he

17 L. Oettinger, "The Use of Deanol in the Treatment of Disorders of Behaviour in Children", in The Journal of Pediatrics, Vol. 53, No. 6, December 1958, p. 671-675.

18 E.M. Fields, "The Effects of Deanol in Children With Organic and Functional Behavior Disorders", in the New York State Journal of Medicine, Vol. 61, No. 6, March 1961, p. 901-905.

felt that there were significant changes in the social and emotional behaviour patterns and learning ability of the children in his study. What Fields considered to be a significant change is not reported in his research, however.

Geller,¹⁹ in a study of seventy-five hyperactive children, corroborates the findings of the other two investigators as he states: "Analysis of the results showed that deanol generally increased the child's power of concentration as manifested in integrative tasks such as puzzle solving". This was demonstrated when fourteen of a group of twenty-five children showed greatly improved performance and nine showed moderate improvement in working the puzzle presented to them. It appears, however, that this level of improvement was judged subjectively, but Geller concludes that Deanol is apparently effective in increasing the child's power of concentration. This conclusion confirms the observations made by other investigators.

Working on the theory then, that an increase in attention span is measurable, and that such an increase might possibly lead to a subsequent increase in the intelligence quotient, the writer now turns to a critical review of the literature in the field of intelligence, in order to ascertain

19 S.J. Geller, "Comparison of a Tranquilizer and a Psychic Energizer", in the Journal of the American Medical Association, Vol. 174, October 1960, p. 481-484.

whether or not the theory, as proposed, has withstood the rigours of experimental investigation.

3. Previous Studies in the Field of Intelligence.

For the most part, the literature is sparsely populated with relevant studies in this particular field, and those which have been conducted are far from being methodologically correct.

Perhaps the most startling reference, and that which gave impetus to the present study, was one that appeared in a United Press International release²⁰ in the summer of 1962. This article outlined the preliminary reports of a hospital in England, which was conducting a clinical trial with Deaner on a group of sixty retarded children at the Saint John's Special Boarding School in Brighton. Unfortunately, this research is not as yet completed, but the first account of it, as reported in the press, was most encouraging, and therefore prompted this writer to launch a more thorough investigation into the potentialities of Deaner.

Chronologically, the first research project to appear in this field was one conducted by Pfeiffer and

²⁰ U.P.I. release summer 1962 (see Appendix 2).

Murphree²¹ early in 1958. These investigators report a double-blind study with Deaner on thirty-five university student volunteers. Small initial doses (ten milligrams) of the drug were compared with identical placebos for a two week period, and thereafter the subjects were allowed to increase, decrease, or discontinue the medication on their own volition. Treatment of this type continued for three months, but during the last six weeks all subjects were on Deaner. The authors considered significant subjective changes in the experimental group to be: increased muscle tone and mental concentration, although the means of measuring these significant changes was not discussed by Pfeiffer and Murphree. Twenty-five of the thirty-five students noted mental stimulation which increased daily in the first week of medication.

This study also corroborated the previously noted effects of Deaner in terms of increased mental concentration, but the methodological errors involved in this research were probably large enough to mask out any significant results which might have been discovered. At the outset, it is not clear, as reported by the authors, as to how many university

²¹ G.C. Pfeiffer and H.B. Murphree, "Stimulant Effect of 2-Dimethylaminoethanol in Human Subjects", in the Journal of Pharmacology and Experimental Therapeutics, Vol. 122, January 1958, p. 60A-61A.

students comprised the experimental group or, indeed, if these groups were even properly matched for relevant variables. The drugs themselves were self administered in a most fortuitous fashion, and any significant results which were obtained were, by the authors' own admission, purely subjective. There were no significant objectively measured physical changes. With such obvious errors in methodology, this paper is of doubtful value in contributing to our understanding of the effects of Deaner.

More specifically in the sphere of retarded children, Palmer and Wright²² conducted a small study with eight subjects at the Adams School for Retarded Children in Los Angeles. The eight children were selected as being typically difficult cases of mental retardation and consisted of: two mongoloids, two with marked hyperactivity, two with hypoactivity, and two with abnormal electroencephalograms. After continuous treatment of approximately six months, it was apparent to the teachers and staff of the school that there had been what they considered to be a significant increase in attention span in each of the treated children. In all eight there was an increase in the facility with which the children

22 Elizabeth Palmer and C.A. Wright, "Some Experiences With the Use of Deaner in Retarded Children", Report read at the Ninth Annual Meeting National Association of Retarded Children, Philadelphia, October 8 to 11, 1958.

learned and, specifically, increases in ability to read, write, and perform tasks requiring muscular co-ordination.

Although the above-mentioned study would seem to indicate the therapeutic nature of Deaner's action, it is not possible to unquestioningly accept the results obtained by Palmer and Wright. Their study utilized a pitifully small number of subjects, with only two representing each group, and it is almost impossible to judge the results of the experiment when a suitably matched control group was not used. In addition, it appears that no formal measure of increased ability, such as a standardized I.Q. test, was employed. The subjective observations of possibly biased staff members constituted the only measure of behavioural changes in all of the eight subjects. Such a research project, while nevertheless suggesting possible further exploration in the field, is in itself primarily unacceptable.

Still in the early years of Deaner's production, Finlayson,²³ at the Ontario Hospital School, Orillia, recognized the potential therapeutic gains which might be obtained with this drug, as applied to the mentally retarded child. To test the effectiveness of Deaner, a single blind study was carried out, using two groups of six children each, from one

23 A. Finlayson, "Report on Deaner", unpublished report prepared at the Ontario Hospital School, Orillia, 1959.

ward of the hospital school. The average age of these subjects was twelve years, and their intelligence quotients varied from the upper idiot to mid imbecile range. The experimental group contained children that had been diagnosed as Psychosis with Mental Deficiency, and the control group was composed of six boys, representing a typical cross section of retarded children, without psychotic impairment. The experimental group was given twenty-five milligrams of Deaner for one week, seventy-five milligrams for four weeks, and finally one hundred milligrams for the remaining week. The results of this experiment demonstrated that approximately half of the subjects in the experimental group were improved in terms of their socialization patterns, and personal mood. There was no change reported in the remaining patients and no changes observed in the control group. No attempts to assess possible I.Q. changes were made in either group. It was the opinion of the experimenter that the drug was not effective in the treatment of the mentally retarded child with schizophrenic or schizoid tendencies.

As can readily be seen, the above-mentioned experiment also possesses obvious methodological errors which detract somewhat from its final conclusions. A small sample of six patients inadequately selected, and compared with a poorly matched control group, is not sufficient to shed much light on the effectiveness of any psychopharmacologic agent.

From the results of this study, it is also impossible to determine if any significant changes in intelligence, if they did occur, could be attributed to the effect of Deaner.

From the January 1960 issue of the Japanese Journal of Child Psychiatry, Okazaki²⁴ reported the results of his research on the effects of drugs with the mentally retarded. Unfortunately, this article is not available in the original but, from an abstract of it, it was noted that dimethylaminoethanol was administered to twenty mentally retarded children of mixed etiology. This experimental group was compared to a control group of seventeen normal children. Okazaki reported that no significant differences were found on intelligence tests or learning tests, but that significant differences were observed on the Mental Work Process Analyzing Test.

While it is undoubtedly unfair to criticize research from its abstract, it is at least possible to point out that again the control group was not adequately matched with the experimental group, thus making it difficult to interpret any results which are obtained, significant or otherwise.

²⁴ H. Okazaki, "Studies of the Effects of Drugs on the Mentally Retarded", in Japanese Journal of Child Psychiatry, Vol. 1, 1960, p. 289-302, abstracted by K. Mizushima in The Psychological Abstracts, Vol. 36, April 1962, p. 342.

Perhaps the most carefully conducted study in this area was one carried out by Clausen²⁵ and his associates at the Vineland Training School in New Jersey.

Forty subjects were selected for this study, and divided into two equal groups. Twenty children were given Deaner and twenty were given placebos, identical in every respect to the active agent. Nine subjects in each group were classified as being emotionally disturbed in addition to mental deficiency. The age range was from eleven to twenty-five years, and the I.Q. ranged from twenty-five to eighty-nine. As part of the experimental design, several psychophysiological tests were utilized, as well as intelligence tests and behaviour rating scales. The intelligence tests used were selected items from the Wechsler Adult Intelligence Scale, and the Wechsler Intelligence Scale for Children. In terms of drug administration, the experimental group was given a seventy-five milligram dose of Deaner for a period of four weeks, after which both groups were re-tested. The dose of Deaner was then increased to 150 milligrams for four additional weeks, and the total test program was again administered after this period. Six weeks

²⁵ J. Clausen, et al., "The Effect of Deaner (2-Dimethylaminoethanol) on Mentally Retarded Subjects", in the Training School Bulletin, Vol. 37, No. 1, May 1960, p. 3-12.

following termination of drug or placebo the battery of tests was administered once again.

The results of this extensive investigation indicated that, in terms of the psychometric tests, the mean difference between the Deaner and placebo group was such that it did not approach a statistically significant level. The authors felt, however, that the drug may possibly have some effects which were not reflected in the scores of the objective tests. Viewing the experiment globally they were of the opinion that Deaner did not improve power of concentration or attention span in their mentally retarded subjects. This belief is certainly at variance with the reported encouraging preliminary and undocumented results from the Brighton study now being undertaken. Such contradictory results would, of necessity, demand further research, in a quest for the ultimate truth in this regard.

It is extremely difficult to find fault with the Vineland research as it has been most carefully conducted, although the reader might wonder at the failure to use a double-blind approach and he might possibly query the validity of the psychometric scales composed, as they were, of several individual subtests. Apart from this, however, one must conclude that the study has definitely increased our knowledge of dimethylaminoethanol.

While it does not specifically apply to the area of Deaner and intelligence, Field's²⁶ study on the effects of deanol in children with behaviour disorders should be referred to again at this time.

In a large scale project, four hundred patients ranging in age from two to nineteen years were given one hundred milligrams of Deaner daily, for a ten month period. While Fields was primarily interested in the effects of the drug on personality and behaviour disorders, ten of the patients were also selected at random and their intellectual status was assessed using the Wechsler Bellevue and Stanford-Binet tests. Contrary to the results obtained by Clausen et al., Fields discovered that all of the ten children in this random sample showed an appreciable and significant improvement in their intellectual attainment. The level of significance in this research is not reported by Fields, but he has pointed out that the increment in level of improvement ranged from plus ten to plus thirty-four, with an average of 20.6 points increase in the intelligence quotient above the subject's basal level.

The above results appear to be most encouraging, and increases of twenty I.Q. points would most certainly be significant. However, these results must be interpreted with

26 Fields, Op. Cit., p. 901-905.

reservation. It must be remembered that these scores represent the efforts of only ten children, five of which had been diagnosed as Schizophrenic. It must also be pointed out that Fields neglected to obtain a random sample of his control group for purposes of comparison with the ten cases referred to above. Quite conceivably the control group might also have experienced a similar increase in intelligence scores. The results of this research, however, would certainly indicate that Deaner has a definite potential for use with the mentally retarded child, a potential which should be further investigated under controlled conditions.

The last study to be referred to in this review of the literature is one by Bell and Zubek,²⁷ which produced some rather startling results.

From the Manitoba School for Mentally Defective Persons, Bell and Zubek obtained a group of seventy-five patients who were diagnosed as cultural familial retardates. These patients were given the Wechsler Adult Intelligence Scale, and were then divided into three matched groups. One group was given fifty milligrams of Deaner twice daily, another five milligrams of d-amphetamine, and the third group was

²⁷ Anne Bell and J.P. Zubek, "Effects of Deanol on the Intellectual Performance of Mental Defectives", in Canadian Journal of Psychology, Vol. 15, No. 3, September 1961, p. 172-175.

given a placebo. The treatments were administered over an eight week period and the study was conducted using the double-blind technique.

The results of this study show that all groups obtained a gain in I.Q. scores on all three scales of the W.A.I.S. It was discovered that amphetamine produced a smaller gain than either Deaner or the placebo, and that in the placebo group there was a greater gain in I.Q. than in either of the other two groups. The placebo group gained 4.40 points on the full scale I.Q. from first to second administration, and the Deaner group gained only 1.60 I.Q. points. The authors conclude from this that Deaner and amphetamine have an adverse, or inhibiting effect, on intellectual performance, as measured by the Wechsler Adult Intelligence Scale.

The results of this research are most definitely contrary to those obtained by other investigators, and the authors themselves do not propose a satisfactory explanation for this, other than to criticize the methodology of the previous investigations. Of course, the subjects of Bell and Zubek's study were adult defectives with a mean age of thirty-eight. Quite possibly Deaner might have an inhibitory effect on the adult brain, while evoking the opposite effect on the brain chemistry of the child. Such a phenomenon is not

unusual, and has been often demonstrated in the case of Dexadrine.²⁸

4. Summary and Statement of Hypothesis.

In the earlier sections of this chapter, the theoretical considerations as to the possible effectiveness of Deaner have been dealt with at length. In the section just considered, a critical resumé of the relevant literature on this drug has been presented, as a framework for the present investigation. With the above review of the literature in mind, the reader is now in a position to judge the value and current status of Deaner, with respect to attempts made to increase psychometric intelligence. Without reflecting too deeply on this review, it is plain to see that the question: Does Deaner increase I.Q.? has been far from adequately answered. With reference to the situation at the present time, however, it would be impossible to make such a decision with any degree of assurance. Some studies have emphatically illustrated that Deaner does in fact increase mental concentration, and others have strongly pointed to definite or potential increments in intelligence quotients. Other investigators are firmly convinced that the drug is valueless

²⁸ S. Arieti (ed.), American Handbook of Psychiatry, New York, Basic Books, 1959, p. 1560.

for the purpose of increasing I.Q., and still others feel that it may have an adverse effect, working to inhibit intelligence scores, rather than increase them. The true answer to the proposed question then, has not been forthcoming, and it was therefore the purpose of the present study to provide such an answer. Specifically, more information was needed as to the influence of Deaner on the psychometric intelligence of the retarded child. The present status of the situation then promoted this research project, and the following basic hypothesis which has been formulated in the null: There will be no significant difference in psychometric intelligence between two matched groups of mentally retarded children, after the administration of dimethylaminoethanol.

CHAPTER II

EXPERIMENTAL DESIGN

The reader is now familiar with the previous research which has been conducted in this field, and with the theoretical considerations that underly the present study. In this chapter, the experimental procedures designed to test the aforementioned hypothesis are presented under the following sections: the tools of the experiment; selection of the sample; the experimental procedure; and statistical evaluations.

1. The Tools of the Experiment.

As it has been stated in the title of this dissertation, it is a study involving Deaner and psychometric intelligence. The pharmacology of Deaner has been adequately dealt with in the previous chapter, but the term psychometric intelligence is yet to be specifically defined. In this study, psychometric intelligence refers to that level of intelligence which is capable of being measured by the Stanford-Binet Intelligence Scale. Since the Binet Scale has been employed throughout this study, the above-mentioned operational definition can be applied for the remainder of the report.

The 1960 revision of the Stanford-Binet was selected for this project for various reasons. The primary reason for this choice was based on the fact that the Binet Scale is more easily adapted to a population of retarded children, and particularly those with mental ages below four or five. The Wechsler Intelligence Scale for Children, although also a highly reliable instrument, is sometimes far too difficult for many retarded children. The Stanford-Binet Scale, being one of high reliability and validity, is well known and appreciated by psychologists and educators alike, and results obtained with its use are likely to be considered of value. Perhaps even more important, however, with respect to the present study, is the fact that the Binet contains several subtests, at all age levels, which are capable of measuring level of concentration and attention span. This aspect of the instrument is considered most imperative as it was necessary to test the theory that, improved attention span would result in an improved intelligence quotient. The most widely recognized subtest for the purpose of measuring increased attention span, or present level of concentration, has been the Digit Span subtest which is utilized in six locations in the Stanford-Binet (Form L-M) Scale, up to the fourteenth year.¹

¹ E.B. Greene, Measurements of Human Behavior, New York, The Odyssey Press, 1941, p. 24.

Digit Span achievement, points out Anderson,² is considered to rest primarily on the function of attention, and he has defined attention as: a relatively effortless, passive, and nonselective registering of stimulation in consciousness. Experience has shown that voluntary effort can not replace the optimal condition of automatic, effortless attention, and attention is absolutely necessary if effective learning is to take place.

Low scores on the Digit Span subtest can be due to anxiety as well as inattention but, in either case, states Wechsler,³ difficulty in the reproduction of digits correlates with lack of ability to perform tasks requiring concentrated effort.

Other subtests of the Binet Scale such as: Memory for Sentences, Memory for Designs, Disconnected Words, and Copying Bead Chains, can also be utilized for the purpose of measuring concentration level,⁴ but these are referred to more fully in a discussion of the results.

Considering the value of the Stanford-Binet then, in measuring attention span and learning ability, it can be readily understood why it was employed in this particular research.

³ D. Wechsler, The Measurement and Appraisal of Adult Intelligence, 4th ed., Baltimore, Williams and Wilkins Co., 1958, p. 70-72.

⁴ Greene, Op. Cit., p. 24.

While not specifically a scientific instrument in the strictest sense of the word, the other psychological tool which was employed in this study is briefly mentioned here. A modified type of rating scale, which was designed by the writer, was used once each week throughout the duration of the experiment to gather further data on behavioural changes of the subjects. This technique, while not resembling the formal rating scale too closely, nevertheless proved useful in many respects. The rationale behind the use of this instrument, and its application to the present research project, is more fully described in a later section of this chapter.

Of course, the remaining and most important experimental tool was the psychotropic agent dimethylaminoethanol, supplied in the form of one hundred milligram tablets of Deaner by the Hiker Pharmaceutical Company.

As it has been stated in the previous chapter, Deaner is the para-acetamidobenzoate salt of 2-dimethylaminoethanol. Dimethylaminoethanol is, itself, a colourless liquid with an amine-like odour, and a specific gravity of 0.885 at twenty degrees centigrade.⁵ Its chemical formula is as follows: $(\text{CH}_3)_2 \text{N} \cdot \text{CH}_2 \text{CH}_2 \text{CH}_2 \text{OH}$, and the chemical formula

⁵ F.M. Turner, The Condensed Chemical Dictionary, New York, Reinhold Publishing Corporation, 1950, p. 238.

of the commercial preparation Deaner is:

$\left[(\text{CH}_3)_2 \text{N} + \text{H} \cdot \text{CH}_2 \text{CH}_2 \text{OH} \right] \left[\text{CH}_3 \text{CONH} \cdot \text{C}_6 \text{H}_4 \text{COOH} \right]$.⁶ It contains 53.8 per cent carbon, 12.44 per cent hydrogen, 15.71 per cent nitrogen, and 17.95 per cent oxygen.⁷

Placebo tablets, identical in appearance to the active agent, were also made available for this research.

2. Selection of the Sample.

It was originally intended by the writer to conduct this research with a sample composed exclusively of Mongoloid retarded children. Such a selection would have eliminated the problem of matching groups in terms of etiology, and would have provided a relatively homogeneous sample. However, due to many methodological difficulties associated with the Mongoloid population, the original idea was partially abandoned in favour of a more thorough and interesting investigation which utilized another etiological classification, in addition to Mongolism. The population of Cultural Familial mental retardates was also sampled, and compared with a sample of Mongoloids, in both the experimental and control groups.

⁶ H.C. Wood (ed.), The Dispensatory of the United States of America, 25th ed., Philadelphia, J.B. Lippincott Co., 1960, p. 52.

⁷ P.G. Stecher (ed.), et al., The Merck Index of Chemicals and Drugs, Rahway, N.J., Merck and Company Incorporated, 1960, p. 369.

It was considered that, by so doing, more valuable information would be added to our present knowledge of the effects of Deaner on psychometric intelligence, and positive results would be of greater assistance to the Cultural Familial retardate than to the Mongoloid, as the latter group is physically stigmatized in addition to being mentally retarded. The sample then, was composed of both Mongoloid and Cultural Familial retarded children in both groups.

For the purpose of clarity, the retarded child is here psychometrically defined as an individual with an intelligence quotient of less than seventy. All the children in this study were well within the limits of this definition.

Insofar as the correct diagnosis of the subjects was concerned, the writer relied exclusively on the results of a professional diagnostic conference which was held for each child. Each patient coming to such a conference is diagnosed by a group of psychiatrists, psychologists, and physicians, with the assistance of the American Association on Mental Deficiency's etiological classification.⁸ Under this professional and universally recognized classification, all Mongoloids are referred to by the number 64 (Mongolism);

⁸ R. Heber, "A Manual on Terminology and Classification in Mental Retardation", in the American Journal on Mental Deficiency, September 1959, Monograph Supplement.

and all Cultural Familial retardates are described as: Mental retardation due to uncertain (or presumed psychologic) cause, with the functional reaction alone manifest, number 81 (Cultural Familial mental retardation).

After a decision had been made as to the type of subjects which would be employed in this experiment, it was then necessary to select a sufficient number of these from the files of the hospital school. When searching through the files for the required diagnostic categories, it was of paramount importance to ensure that no potential subjects also suffered from Grand Mal Epilepsy in addition to their primary diagnostic classification. This insurance measure was necessary, as the drug dimethylaminoethanol is contraindicated in cases of Grand Mal Epilepsy. It was necessary to reject many subjects for this reason, and others were rejected because they did not fall within the age range of approximately six to twenty, which had been arbitrarily set by this investigator.

When these initial requirements had been met, each of the selected candidates (approximately seventy of them) were subjected to a thorough psychometric evaluation with the Stanford-Binet Intelligence Scale. All tests were administered by the writer, under similar environmental conditions, and it was adjudged that the majority of subjects turned in their optimum performance.

With the accumulation of this data on the I.Q.'s of all the subjects, and the collection of further information with regard to age, sex, weight, and previous drug administration, it was possible to begin forming two matched groups, in accordance with the suggestions proposed by Townsend.⁹

In order to obtain matched groups that were as closely alike as possible, an effort was made to match each individual subject with another patient that possessed a similar set of statistics, with regard to the relevant variables being considered. Although it was not entirely possible to do this in every case, such a procedure, while not producing the matched pairs technique, did result in two well matched groups. When this matching procedure had been completed, the two selected groups of subjects closely resembled each other in every respect, and the variability about the mean with regard to all statistics was approximately equal in all cases. At the outset, both groups of subjects were composed of thirty-two patients, eighteen boys and fourteen girls in each. This was further broken down to: seven Mongoloid boys, and seven Mongoloid girls, eleven Cultural Familial boys, and seven Cultural Familial girls, in

⁹ J.C. Townsend, Introduction to Experimental Method, New York, McGraw-Hill Book Company Inc., 1953, p. 62-63.

each of the two groups. The other relevant variables in terms of age, weight, and I.Q. were also evenly matched, and this information is presented in Table I on the following page.

It was felt that a match for previous drug administration would also be necessary, as any possible effects of a psychic energizer should not be confounded by results that may have been produced by tranquilizing agents. However, due to the type of subjects that was employed in this experiment, this problem was not a serious one to overcome. Since considerable care had been taken previously to eliminate all cases of Epilepsy from the sample, no subject was therefore on anticonvulsant medication. Also, due to the fact that the majority of Mongoloids are of even disposition, the need for tranquilizing medication in this group was entirely non-existent. In addition, all Cultural Familial subjects in this research were also free from the effects of tranquilizers. It became necessary, however, for one girl in the experimental group to be placed on rather large doses of a tranquilizing agent due to a severe outburst of anti-social behaviour. This subject was then immediately dropped from the study for the remainder of its duration.

With this information, it is possible for the reader to see that both groups used in this study were equal in all respects prior to drug administration. At this point the

Table I.-
Preliminary Statistics on Matched Groups.

Variables	Experimental Group	Control Group
No. of Subjects	32	32
Boys	18	18
Girls	14	14
No. of Mongoloids	14	14
Boys	7	7
Girls	7	7
No. of Cultural Familials	18	18
Boys	11	11
Girls	7	7
Average Age	13	13
Standard Deviation	3.86	3.86
Range	7-22	7-22
Mongoloids	13	13
Cultural Familials	13	14
Average Weight (pounds)	91	96
Standard Deviation	30.91	36.60
Range	48-165	43-163
Mongoloids	86	84
Cultural Familials	94	106
Average I.Q.	43	43
Standard Deviation	13.55	12.80
Range	22-67	17-66
Mongoloids	31	31
Cultural Familials	52	51
Boys	44	44
Girls	41	41

writer now moves to a description of the experimental procedures that were carried out for the remainder of the clinical trial.

3. The Experimental Procedure.

When the two suitably matched groups had been arranged, the next task was to arbitrarily assign one of these two to the experimental group, and the other to the control group. It was decided that the use of the double-blind technique would be the best method for this purpose and for the remainder of the experiment itself. Consequently, two lists of names were submitted to the hospital pharmacist, and he arbitrarily decided which group would receive the Deaner and which group would receive the matching placebo tablets. To further ensure that the study would remain a double-blind, all tablets were removed from the manufacturers' bottles and replaced in unmarked containers supplied by the hospital pharmacy. At this time, the active agent was assigned the label of "Pill A", and the placebo tablets were correspondingly labeled "Pill B". For the duration of the experiment itself, and up until the time of the second re-testing, neither the writer nor any of the other hospital staff members had any knowledge as to which tablet actually contained dimethylaminoethanol. In addition to this, the ward staff who were in close contact with the children on a

day-to-day basis were entirely ignorant of the purpose of the study or of the type of psychotropic agent that was being utilized. With these precautions taken, it was therefore possible to state with assurance that all experimental results were interpreted objectively and that no member of the staff had aided or interfered with the experimental group in any way.

The senior staff members on each ward were responsible for the dispensing and administration of both the drug and placebo to all the subjects involved. Careful record was kept of the names of all the children receiving these pills, and periodic checks were made by the writer to ensure that each child had indeed received his proper medication (either Pill A or Pill B). All ward staff co-operated well in this respect and there was a minimum of confusion and error. The actual administration of drugs was commenced on the morning of June 17, 1963, and the first pills were given to the patients at eight A.M. As a precautionary measure, all subjects were started on only one oral dose of the drug consisting of one hundred milligrams of Deaner for the experimental group. This step was taken to protect any patient from receiving too high a dose, and perhaps developing unpleasant side effects, such as overstimulation. All patients remained on one hundred milligrams per day for the duration of the first experimental week. During this period

they were carefully observed for any effects which might possibly force their removal from the study. Since no patient developed undesirable symptoms, all children in the experimental group were placed on two hundred milligrams of Deaner at the beginning of the second week of treatment. This amount was given in two divided doses per day, one at eight in the morning, and the other at four in the afternoon. The control group was given matching placebos at the same times. All children, then, received two tablets per day for the remainder of the study which continued for seven additional weeks. The total length of time utilized for the actual experiment was eight seven-day weeks, from June 17, 1963, up to and including August 11, 1963. At this latter date, the re-testing program was begun.

As it is recognized by all, that the experimental and control group must be adequately matched at the outset of any experiment, it is also recognized that both groups should receive equal treatment throughout the experiment itself, that is, with the exception of the experimental condition. Only one variable should be allowed to fluctuate at one time if a sensible interpretation of results is to be attempted. In this case, both groups received similar environmental treatment throughout the experimental eight weeks, and the only significant difference was that one group was given Deaner while the other group was given a

placebo. In order to give all patients an opportunity to increase their intelligence, or profit by a possible increase in attention span, provisions were made for members of both groups to attend the summer school sessions that are provided by the hospital school. While this experience was no doubt of limited scholastic value due to the low I.Q. of some of the patients, it nevertheless provided them with a useful activity and an opportunity to capitalize on a probable increase in learning ability.

When the subjects were not occupied with school activities, their time was spent in recreation on their respective wards. Since a careful effort was made to ensure that each ward contained approximately the same number of control and experimental subjects, it is not likely that differential after school treatment would affect the results of the study.

Unfortunately, while the study was in progress some patients left the hospital on extended periods of probation lasting up to six weeks. However, this is not considered to be a significant variable, as the same number of patients (i.e. four) were absent from each group for this purpose. Care was also taken to ensure that these patients took with them an adequate supply of their respective drugs. Consequently, it is not likely that differential home treatment during this probationary period significantly affected the comparison between the experimental and control group.

Throughout the experimental period, a report was obtained each week from the ward staff, on any behavioural changes or other significant differences that were manifested by the patients. This plan, to simply ask for several opinions with regard to changes, was adopted in favour of a formal rating scale for several reasons. Firstly, it is well known by most investigators that, even under the most favourable of circumstances, the behaviour rating scale does not yield a high coefficient of validity. Clausen¹⁰ had used one in his study and found that it yielded little or no significant information. Secondly, and perhaps the most important reason as applied to this research, was the fact that the double-blind technique did not lend itself to a formal scale. The ward staff had been alerted to look for any possible changes which might occur in both groups of patients. They were particularly curious as to the reason for the pills, and hence were in a high state of suggestibility. It was felt that, under these circumstances, formal questioning would only serve to give the staff something definite to look for, and hence something definite to report, regardless of whether or not such an observation had been objectively made. In other words, it was not the intention of the writer to bias the staff by asking them to rate

¹⁰ J. Clausen, et al., "The Effect of Deaner (2-Dimethylaminoethanol) on Mentally Retarded Subjects" in the Training School Bulletin, Vol. 57, No. 1, May 1960, p. 3-12.

specific traits. It was considered that more valuable information could be obtained if the ward attendants were simply alerted to watch for any behavioural changes that might take place. In addition to this, it was not known specifically, what changes could be expected in a population of retarded children and hence the construction of a formal rating scale would have been somewhat of a gamble at any rate.

This technique then, of asking for staff opinions on behaviour changes, was utilized at the beginning of each week and three weeks after the termination of the study, in the following manner.

All staff and supervisors had been requested to watch closely for any possible changes in both groups of children on their ward. Each Monday morning a survey of these staff members' observations was conducted by the writer. Attendants were asked, individually and collectively, for their observations over the previous week. These comments were carefully sorted out and recorded during each week of the investigation. One final survey was conducted three weeks after cessation of the drug to determine if any changes had resulted from the withdrawal of Deaner.

Upon the completion of the eight weeks clinical trial which had been conducted with Deaner, all subjects were re-tested with the Stanford-Binet Intelligence Scale.

This re-testing program was conducted entirely by the writer, and under environmental circumstances closely resembling those of the original testing sessions. All re-testing was done within a ten day period, with the patients being maintained on drug and placebo up to and including the actual day of re-testing. After the psychometric evaluation had been completed on a patient, his drug treatment was directly cancelled.

Owing to the fact that Deaner does not possess a delayed action effect, or permanent effect with short term administration, a third re-testing program was ruled out as unnecessary in this experiment. In reply to specific questions in this regard, Colket of the Clinical Pharmacology section of Riker Laboratories Incorporated, states:

1. If there are to be any positive effects of Deaner on intelligence they would be noticeable after approximately eight weeks of treatment.
2. The drug does not have a delayed effect.
3. On short term treatment, positive effects of Deaner would not be permanent. They would die out approximately one to two weeks from the time when the treatment was stopped.¹¹

Due to the nature of this information, it was decided that a third re-testing would be a most unproductive and entirely unnecessary effort.

¹¹ T.C. Colket, Personal Communication with the Author, Northridge, California, Riker Laboratories Incorporated, June 20, 1963, p. 4.

4. Statistical Evaluation.

The prime consideration of this research project was to determine whether or not any obtained differences in I.Q. scores between the experimental and control groups after drug administration could be attributed solely to chance.

In order to answer the above question, a test for statistical significance was necessary. In this project, a *t* test was employed for this purpose, and the following steps were undertaken.

Firstly, since matched groups were utilized, it was necessary to calculate a coefficient of correlation which would be applied in the formula for the standard error of the difference between means. This correlation was calculated using the total number of subjects in both the experimental and control groups, after dropouts. The variables which were correlated were, initial I.Q. with I.Q. changes. This procedure was repeated three times, once for the total group, once for the subgroup of Cultural Familials, and once for the subgroup of Mongoloids.

Having obtained these correlation coefficients, it was then necessary to calculate the means, standard deviations, and standard errors of the means, for the following six groups: experimental, control, Mongoloid experimental,

Mongoloid control, Cultural Familial experimental, and Cultural Familial control. These figures were based on the difference scores between first and second I.Q.'s.

With this information, it was then possible to calculate the standard error of the difference between means, using the following formula:

$$\sigma_{diff} = \sqrt{(\sigma_{M_1}^2 + \sigma_{M_2}^2) (1 - r^2)}$$

This formula was applied for each of the three comparisons being made, and the obtained value for the standard error of the difference between means was utilized in the final *t* test. This formula is given below as:

$$t = \frac{M_1 - M_2}{\sigma_{diff}}$$

This *t* test was also applied three times to test the significance between:

1. The experimental and control groups, after drug administration;
2. The Mongoloid experimental group and Mongoloid control group, after drug administration; and,
3. The Cultural Familial experimental group and Cultural Familial control group, after drug administration.

Finally, all checks for significance were made using a table of t ratios, and taking into account the appropriate number of degrees of freedom in each case.

In this chapter, the entire experimental procedure of this research project has been described in order to give the reader the proper framework for interpreting the succeeding chapter on the presentation of results. To briefly recapitulate: A sample of thirty-two patients, composed of Mongoloid and Cultural Familial retarded boys and girls, was matched for all relevant variables, with a similar control group. After an initial testing program, the experimental group was placed on Deaner (two hundred milligrams) for a period of eight weeks. The control group received placebo tablets, and both groups were re-evaluated at the termination of the eight week period. The results of this evaluation are presented in the following chapter.

CHAPTER III

RESULTS AND DISCUSSION

In this chapter, the results which were obtained after the administration of Deaner to a group of mentally retarded children are presented, and their implications are discussed in the light of the more general problem of increasing intelligence. This discussion is conducted under the following headings: The Basic Results, where actual I.Q. changes and their significance are presented; An Examination of the Subtests, at which point the attention span items and others are more closely investigated; and Observed Behavioural Changes, where the behavioural manifestations attributable to Deaner are discussed.

1. The Basic Results.

The following results which were obtained after an eight week clinical trial with Deaner are based on only those individuals that continued throughout the entire experimental period. That is, those subjects who for one reason or another dropped out of the study, were not considered in the second psychometric evaluation, after drug administration. Four subjects were involved in this category, three in the experimental group and one in the control group. One of these subjects was dropped from the study,

as it was necessary for her to be placed on tranquilizing medication. The remaining three patients were simply not available at the time of re-assessment. In all of the post matching statistics then, these four subjects were not considered, and results are based solely on the remaining sixty patients. Due to the fact that three subjects were deleted from the experimental group and only one from the control group, the mean I.Q.'s of the groups were no longer as closely related as they had been at the time of matching. With dropouts taken into account, the mean I.Q.'s of the experimental and control groups before drug administration were 41.79 and 42.97 respectively. This represented a difference of 1.18 I.Q. points higher, in favour of the control group.

With the above figures to be used as a comparison, it was discovered upon psychometric re-evaluation that the experimental group had gained 1.69 I.Q. points on the average after eight weeks of treatment. At this time, the mean I.Q. of the experimental group was 43.48, and the mean I.Q. of the control group was 42.87.

When a correlation of .32 was considered between initial I.Q. scores and changes in I.Q.'s, it was discovered that the above mean difference of 1.79 I.Q. points between the experimental and control group was statistically significant at the .02 level of probability, for fifty-eight

degrees of freedom. This information is presented in Table II on the following page.

While this increase in I.Q. was slight, it was nevertheless significant, and suggests the possibility that a larger dose of Deaner might bring about more startling results. Further discussion of this point is postponed, however, until the results of the subgroups have been examined.

While the overall significance reported above was calculated from the sum of the scores of Mongoloids and Cultural Familiars, it can be seen from an examination of Table III that the Mongoloid subgroup contributed almost nothing to the significant results of the total group. At the outset, the experimental group of Mongoloids registered a mean I.Q. of 31.21, which dropped to 31.07 after drug administration. The control group on the other hand dropped even further, from an initial mean I.Q. of 31.31 to a post drug I.Q. of 30.54. This represented an average loss of .77 I.Q. points as compared to a loss of only .14 I.Q. points in the Mongoloid experimental group. However, this difference of .63 I.Q. points between the experimental and control Mongoloid subgroups, while nevertheless favouring the Deaner group, was not sufficient to be statistically significant at either the .01 or .05 level.

Table II.-

Results of Total Groups After Drug Administration.

Variables	Experimental Group	Control Group	Differences
Number of Subjects	29	31	2
Total I.Q. Change	49	-3	52
Mean I.Q. Change	1.69	-.10	1.79 ^a
Standard Deviation	2.87	2.61	
Standard Error of Mean	.54	.48	

^a This difference is significant at the .02 level of probability.

Table III.-

Results of Mongoloid Groups After Drug Administration.

Variables	Experimental Group	Control Group	Differences
Number of Subjects	14	13	1
Total I.Q. Change	-2	-10	8
Mean I.Q. Change	-.14	-.77	.63 ^a
Standard Deviation	1.31	2.80	
Standard Error of Mean	.36		

^a This difference is not significant at the .01 or .05 level.

It would appear then, that Deaner had little or no effect on the brain chemistry of the Mongoloids in this research, at least in the amounts administered. Both experimental and control groups registered a mean loss of I.Q. points after treatment with Deaner and placebos. However, interestingly enough the experimental group regressed less than the control group. But since this difference was not significant, it would not be justifiable to conclude that this drug had any positive effects in this sample of Mongoloids, as far as raising I.Q. is concerned. Quite obviously then, the significant results of the total group were comprised almost exclusively from the sample of Cultural Familial retardates.

The question then arises as to why there should be no positive effects in the sample of Mongoloids. While this is undoubtedly a difficult, if not impossible question to answer, some suggestions can be presented for discussion.

First of all there is the implication, which unfortunately has not been well documented, that there occurs a progressive retardation of the Mongoloid's mental development, even after birth.¹ If this were indeed the case, one would expect a progressive deterioration in I.Q. scores with

¹ R.L. Masland, et al., Mental Subnormality, New York, Basic Books Inc., 1958, p. 89-92.

advancing age, as a natural concomitant of Mongolism. Any chemical agent then, would have to overcome this progressive deterioration of brain cells, before it could begin to effect an increase in mental development. Perhaps a larger dosage of Deaner, or an extended period of treatment, might bring about statistically significant positive results, although this is probably not likely.

Perhaps a more feasible explanation for the obtained negative results of this subgroup lies in the fact that Mongoloid brains are clearly abnormal, and show signs of widespread interference with the growth of brain cells. Benda² has stated that there is abnormality of the thyroid, adrenal, and pituitary glands, and anomalies in sugar and cholesterol metabolism, in the majority of Mongoloids that he has examined. Autopsies have also shown that the brain itself reveals a decelerated maturation. The nerve cells are often undersized and show severe degrees of cell degeneration.³

As an explanation of negative results then, it is quite possible that Deaner simply does not function in the

² C.A. Benda, "Research in Congenital Acromicria (Mongolism) and Its Treatment", in the Quarterly Review of Pediatrics, Vol. 8, 1953, p. 79-96. Quoted by L. Kanner, Child Psychiatry, Springfield, Illinois, Charles C. Thomas, 1957, p. 274.

³ Masland, Op. Cit., p. 89-92.

presence of abnormal brain development. This statement becomes more plausible when the results of the Cultural Familial retardates are examined.

Of course, there is always the possibility that negative results could be attributable to the type of psychometric instrument being employed. Perhaps the abilities that Deaner is presumed to increase are simply not being adequately measured by the Stanford-Binet at this mental age level. However, as it has been pointed out before, the difficulties inherent in other psychometric instruments, militate against their use in a population of moderately retarded children.

In contrast to the rather disappointing results of the Mongoloid subgroup, the essentially positive scores of the Cultural Familial subjects were somewhat more encouraging. (See Table IV.)

In the experimental group of Cultural Familials, the mean I.Q. rose from 51.67 to 55.07 after eight weeks of treatment with Deaner, while the mean I.Q. of the control group rose from 51.38 to only 51.78. This increase of 3.40 I.Q. points in the Deaner group, as compared to an increase of .40 I.Q. points in the placebo group, was clearly significant at the .02 level of probability, for thirty degrees of freedom.

Table IV.-
Results of Cultural Familial Groups After Drug
Administration.

Variables	Experimental Group	Control Group	Differences
Number of Subjects	15	18	3
Total I.Q. Change	51	7	44
Mean I.Q. Change	3.40	.40	3.00 ^a
Standard Deviation	3.79	2.46	
Standard Error of Mean	1.01	.60	

^a This difference is significant at the .02 level of probability.

Quite obviously then, there is a considerable difference between the reaction of Mongoloids and Cultural Familial retarded children to Deener, at least for the present study. While it is also difficult to explain this significant increase in the Cultural Familial group, it is probably likely that this phenomenon is a function of the type of retardation involved. As it was postulated previously that the negative results of the Mongoloids were due to abnormal brain chemistry, it is now postulated that the reverse must be true for the Cultural Familial subjects. In this case the drug is acting on an essentially normal brain structure, and it is likely that this makes a considerable difference in terms of positive drug effects.

As White⁴ has pointed out: In the case of Familial retardation the brain is not working very well, but there is no evidence for any gross structural defect. It is suggested simply that Familial retardation represents the lower end of the curve of distribution for innate intellectual endowment.

The diagnosis of Cultural Familial retardation rests solely on the presence of mental deficiency in the family, and the absence of organic or environmental causes.⁵

⁴ R.W. White, The Abnormal Personality, New York, The Ronald Press Company, 1956, p. 485.

⁵ W.J. Coville, et al., Abnormal Psychology, New York, Barnes and Noble, 1960, p. 213.

In the case of the Familial retardate then, it is quite possible that the absence of any organic brain pathology allows the therapeutic action of Deaner to operate as it is intended to do. The question of whether or not attention span is increased, hence leading to an increased I.Q. is dealt with in the next section of this chapter.

Regardless of the explanation for this increased intelligence score, however, it does suggest further possibilities for this group of retarded children, in spite of the fact that the actual I.Q. increase was slight. Perhaps with an increased dosage of Deaner, or an administration over a protracted period of time, or both, the I.Q. could be raised to a greater extent. Even if this were not possible with Deaner alone, there is a suggestion that the Cultural Familial retardates would profit considerably more from any attempts to increase intelligence, than would the Mongoloid retarded children.

2. An Examination of the Subtests.

As it has been stated previously, Deaner has been reported to increase attention span, and it has been theorized in this dissertation that an increase in attention span would result in an increased intelligence quotient.

As Tiffin⁶ has illustrated, the effect of attention on the higher mental processes is to make us more responsive to relevant and less responsive to irrelevant matters. Hence it is easy to see why attention increases learning efficiency. Clear perception, clear analysis, fixation and retention, imagination, and logical association are all stimulated by focusing effort on the task at hand, and all of these are essential to efficient learning.

Tredgold⁷ feels that attention varies greatly in the retarded, but is undoubtedly an important factor in their ability for learning. It is clear, therefore, that attention span is an important facet of intellectual ability. What is not clear, however, is whether or not attention span was increased by Deaner in this group of mentally retarded subjects. In an attempt to answer this question, the following analysis of Binet subtests was undertaken.⁸ These results are presented in Table V.

Since the items of the Stanford-Binet are scored simply as a pass or fail, the only way to evaluate a possible increase in attention span was to determine if a greater number of subtests capable of demonstrating attention span, were passed after drug administration, than before. This

6 J. Tiffin, et al., The Psychology of Normal People, Boston, D.C. Heath and Company, 1940, p. 237.

7 A.F. Tredgold, A Textbook of Mental Deficiency, Baltimore, The Williams and Wilkins Company, 1952, p. 411.

8 Subtests capable of measuring attention span were referred to in Chapter II, p. 27.

Table V.-
Mean Number of Stanford-Binet Items Passed.

	Mean No. of Subtests Passed		Attention Span ^b Subtests Passed	
	Before ^a	After	Before	After
Mongoloid Experimental Group	12.85	13.14	.50/1.36	.57/1.36
Mongoloid Control Group	14.46	14.23	.69/1.38	.46/1.38
Cultural Familial Experimental Group	12.33	15.67	1.13/3.13	.73/3.13
Cultural Familial Control Group	13.50	14.55	1.67/3.94	1.50/3.94

a Before and After refers to Pre drug and Post drug tests respectively.

b The figure to the left of the stroke is the mean number of items passed. The figure to the right of the stroke is the mean number of items attempted.

evaluation was made by totalling the number of passed items, in relation to the number attempted. Since the subtests are arranged in ascending order of difficulty from one age level to another, any increase in the number of attention span tests passed would no doubt represent a true increase in attention span. It might be postulated, however, that the sample of Mongoloids would show no appreciable increase in this ability due to the fact that they registered no significant increase in actual I.Q. The above assumption proved to be correct in the case of this subgroup, as neither the experimental nor the control group experienced any startling change in the number of attention span subtests passed. The Mongoloid experimental group on the whole succeeded on only seven subtests out of nineteen attempted, before drug administration. After treatment with Deaner, the total score of the group rose to only eight tests passed out of nineteen attempted. This increase of .07 subtests on the average, could hardly be considered as statistically significant. The control group, however, dropped .23 subtests on the average, from first to second administration. It appears to be clear from these results that attention span was not increased in this sample of Mongoloid retarded children.

On the other hand, since the Cultural Familial experimental group did show a small but significant gain in I.Q.,

it might be expected that they would also show a small but significant gain in the number of attention span items passed. This expectancy was not upheld by the actual results, however. In the total Cultural Familial experimental group before drug administration, seventeen attention span subtests were passed out of a total of forty-seven attempted, but after eight weeks of treatment with Deaner, the number of items passed had dropped to only eleven out of forty-seven. Instead of an increase in attention span then, this group appeared to decrease in this ability. In the control group of Cultural Familiars, there was a total drop of only three attention span subtests. The above results would tend to indicate that attention span was not increased, to a measurable degree, by the use of Deaner. Consequently, the proposed theory that increased attention span would result in an increased I.Q. must be abandoned in favour of a more acceptable explanation.

Upon close examination of the test records, of all the individuals in the experimental group who increased in I.Q., it was discovered that no one factor contributed to this increase. In the case of some individuals, attention span subtests did account for their increased intelligence score. However, with other subjects different subtests contributed to increased scores. Almost every subtest was represented here, as one that was passed on the second

administration but not the first. Increases were demonstrated on such items as: Vocabulary, Verbal Absurdities, Block Counting, Comprehension, Number Concepts, and Opposite Analogies. However, no one type of subtest contributed significantly more than another to the overall increase that was demonstrated in the Cultural Familial experimental group. Consequently, it is probably safe to state that the increased I.Q. was not due to an increase in attention span, or any other specific ability, but was most likely the result of an increase in general mental ability. As a psychic energizer, Deaner has been purported to activate or stimulate the cerebral cortex, and hence increase mental activity.⁹ If such effects did occur, it is possible that the experimental subjects became more alert and responsive to their environment, which in turn allowed them to increase their general mental abilities, and hence their I.Q. As might be expected, this occurred in the subgroup of Cultural Familial retardates, where there is no evidence for organicity, and not in the Mongoloid subgroup, where there is a clearly demonstrable defect in brain chemistry. However, such an explanation must at this time be pure conjecture, as there is no positive method of determining exactly what did occur in this sample of retarded children. An examination

⁹ See Chapter I, p. 2.

of behavioural changes, however, might help to shed some further light on the problem. This aspect of the experiment is discussed in the following section.

3. Observed Behavioural Changes.

Throughout the experimental period itself, some behaviour changes in the patients were observed and reported on by the ward staff. While care was taken to ensure that these reports represented an agreement of opinion, and that no staff member was influenced in his statements, it was impossible to control for differential enthusiasm on the part of the staff. There was, therefore, the possibility that some wards would report a greater number of changes than others. However, this would not likely affect a comparison between experimental and control groups, as the subjects were evenly distributed throughout the hospital.

The first report on behaviour was obtained one week after the commencement of drug and placebo. This report was essentially non informative, as no ward had observed any changes resulting from the administration of Deaner or placebo. At the close of the second week, however, some slight changes were observed in three of the children in the experimental group. It was reported that they were considerably more alert, more co-operative, and perhaps a little happier. These changes continued throughout the third week,

and at this time it was observed that three other children from the experimental group had experienced improvements in their overt behaviour. It was reported that these three were much less troublesome, and had appeared to be considerably more alert mentally. Throughout the duration of the clinical trial with Deaner, these individuals continued to maintain their reported level of improvement and, as the experiment continued, more names were added to the list of apparent beneficial effects. Unfortunately, however, all of these subjects were not members of the experimental group. It can only be surmised that, the ward staff, having observed possible improvements in some patients, were even more alert in watching for them in others.

Three weeks following the termination of drug and placebo, another survey was conducted to determine whether or not the reported beneficial effects of Deaner had subsided. It was reported at this time that all the subjects who had previously improved had regressed once again to their pre drug level of behaviour. Independent observers stated that they no longer noticed the degree of mental alertness they had observed during drug administration. The staff reported that these patients did not appear to be as interested in their surroundings as they had been previously, and that they were now more active and aggressive than before.

In an effort to determine whether or not these reported changes were valid, an individual examination of experimental and control subjects was undertaken, and the results of this analysis are presented in Table VI.

From a total of sixty patients involved in this experiment, it was reported that fifteen of them demonstrated obvious behavioural changes. Eleven of these fifteen subjects were in the experimental group. In the subgroup of Mongoloids, behavioural improvements were reported for five individuals in the experimental group. For these children, the staff were under the impression that they had become happier, more relaxed, and more alert physically and mentally. One Mongoloid subject in the placebo group also experienced a change in behaviour, according to the reports of the ward staff. This individual had become increasingly more talkative, and was creating more of a disturbance on the ward since the initiation of the clinical trial. A similar phenomenon was also observed in the control group of Cultural Familial subjects, although in this case behavioural changes were considered to be improvements, according to the reports of the attendants. In the Cultural Familial control group, three patients were reported to have been greatly improved after treatment with Pill B (placebo). In contrast to this, however, six patients in the Deaner group of Cultural Familials experienced behavioural improvements,

Table VI.-

Number of Subjects Reported Improved as a Result of Drug Treatment.

Variables	<u>Experimental Group</u>		<u>Control Group</u>	
	No. of Subj. Improved	% of Group	No. of Subj. Improved	% of Group
Mongoloids	5	35%	1	8%
Cultural Familiars	6	40%	3	17%
Total	11	38%	4	13%

as observed by several of the staff members. It was said of these patients that they were more co-operative, less troublesome, happier, more outgoing, and more active. In all cases, a regression to their previous level of behaviour was noticed after termination of drug and placebo.

The question arises here as to the value of these observations, especially when improvements were also reported in children receiving nothing but placebo tablets. While behaviour changes were noted in both the experimental and control groups, fewer changes were observed in the placebo groups. It is quite possible that such an occurrence could be attributable purely to chance. In a sample of sixty patients, four of these could possibly improve without any medication whatsoever. Such an improvement, however, would be especially noticeable since the staff had been alerted to watch for any changes in these subjects. In spite of the fact that a small proportion of the total number of subjects actually demonstrated any marked improvement, there were, nevertheless, more of these individuals in the experimental group than there were in the control group. It is likely then, that Deaner did bring about some positive changes in observed behaviour, with increased alertness in appearance being most frequently observed. Interestingly enough, however, there appeared to be no definite correlation between improved behaviour, as observed, and improved I.Q. Those

individuals in the Cultural Familial experimental group who demonstrated behavioural changes, rose only 3.16 I.Q. points on the average, while the remaining experimental subjects in that sub-group gained an average of 3.56 I.Q. points from first to second administration.

4. Summary of Results.

After an eight week clinical trial with Deaner, small but significant increases in I.Q. were obtained in the experimental group. These results which were significant at the two per cent level of probability were almost exclusively composed of the scores from the Cultural Familial subjects. It was discovered that the Mongoloid sample did not produce significant gains in I.Q.

All subjects showed very few gains, if any, on attention span subtests, and this fact led to the rejection of the hypothesis that increased attention span would account for an increased I.Q. Alternate explanations were proposed in an attempt to explain the significant results.

Finally, reports on behavioural changes were presented, and it was noted that only thirty-eight per cent of the experimental group were said to have been somewhat improved as a result of treatment with Deaner.

SUMMARY AND CONCLUSIONS

In an effort to cast more light upon the problem of drugs and their influence on intelligence, the present study was undertaken and a null hypothesis formulated thus;

There will be no significant difference in psychometric intelligence between two matched groups of mentally retarded children, after the administration of dimethylaminoethanol.

Upon the completion of an eight week clinical trial with Deaner, it was found that the above hypothesis was only partially upheld. Since the experimental subjects were composed of individuals from two etiological classifications, differential results were obtained from each of these subgroups. In the sample of Mongoloid retarded children, the null hypothesis was upheld, and no significant differences in I.Q. were obtained as a result of treatment with Deaner. In the subgroup of Cultural Familial subjects, however, obtained differences in I.Q. were statistically significant at the .02 level of probability. When the total group was considered as a unit, results were also significant at the two per cent level. It was clear, however, that these results were composed almost exclusively from the scores of the Cultural Familial subjects. This fact led the writer to conclude that Deaner did not affect the psychometric intelligence of the Mongoloids in this sample, but did exert a small but significant influence on the Cultural Familial subjects.

According to the results of this research, few if any gains in attention span were achieved due to the effects of Deaner. Attention span, as measured by the Stanford-Binet subtests, was not significantly increased in any of the subgroups in this experiment. The fact that no one specific ability could be discovered to account for the significant rise in I.Q., led to the conclusion that attention span was not increased but that gains in intelligence were due to increases in general mental ability.

In addition to the quantitative results obtained in this research, it was discovered that few experimental subjects actually demonstrated any positive improvements in behaviour after eight weeks of treatment with Deaner.

Viewing the results of this research globally, it was possible to conclude that: Deaner, in the amounts administered, did bring about small but significant gains in psychometric intelligence in the subgroup of Cultural Familial subjects, while producing no positive results in the sample of Mongoloid retarded children. These results would tend to suggest the following possibilities for further research.

In spite of the fact that well controlled drug studies usually tend to show few significant results in the field of intelligence, the slight increases in I.Q. which were obtained with Deaner in the Cultural Familial subjects

point to the possibility of even greater increases under optimum conditions. With an increased daily dose of Deaner, administered over a longer period of time, more startling changes in I.Q. might be noticeable. Such a possibility is worth investigating in this subgroup of retarded children. Apart from the area of drug investigations per se, the comparatively positive results obtained with the Cultural Familial subjects in this experiment would suggest further research in all areas with this group of retarded children. Without obvious physical stigmata or organic brain damage, this group definitely offers more possibilities than do the Mongoloids. It is doubtful if any farther attempts to increase the I.Q. of Mongoloids, with psychotropic agents, would be significantly effective.

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The article describes an experiment with several psychotic patients who had been placed on Deaner. It is stated that the drug is capable of stimulating learning.

APPENDIX 1

A SAMPLING OF THE RAW DATA

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Table VII.--

The Mongoloid Experimental Group.

Subject	Initial I.Q.	Final I.Q.	Age	Weight (lbs.)	Sex
Gary B.	29	28	8	55	Male
Richard G.	24	23	16	135	Male
William H.	22	21	17	127	Male
Paul J.	23	23	9	69	Male
Andrew N.	35	35	12	62	Male
Kenneth N.	30	31	7	59	Male
David S.	38	39	22	145	Male
Patricia C.	45	43	9	55	Female
Elizabeth J.	38	41	11	61	Female
Donna K.	22	22	18	115	Female
Nancy L.	34	32	12	91	Female
Victoria M.	27	27	7	48	Female
Georgina N.	41	42	14	78	Female
Denise S.	29	28	17	105	Female

Table VIII.-
The Cultural Familial Experimental Group.

Subject	Initial I.Q.	Final I.Q.	Age	Weight (lbs.)	Sex
William S.	58	60	12	65	Male
Donald S.	58	62	16	165	Male
Mait Q.	67	71	15	92	Male
Wayne W.	42	42	16	101	Male
George J.	66	71	8	68	Male
William I.	47	52	13	115	Male
Thomas H.	47	52	17	108	Male
Donald B.	57	59	9	57	Male
Norman B.	43	43	12	60	Male
Sharon S.	43	46	19	99	Female
Catherine R.	57	60	10	83	Female
Shirley L.	53	58	14	94	Female
Patricia K.	43	47	9	68	Female
Barbara H.	33	38	16	120	Female
Barbara C.	61	65	13	80	Female

Table IX.-
The Mongoloid Control Group.

Subject	Initial I.Q.	Final I.Q.	Age	Weight (lbs.)	Sex
Donald W.	17	16	16	105	Male
Michael S.	40	36	8	72	Male
George S.	29	29	17	105	Male
Timothy P.	30	35	7	46	Male
Larry K.	23	23	18	120	Male
Robert F.	35	34	15	142	Male
David B.	25	25	8	43	Male
Barbara Z.	44	37	9	61	Female
Deborah W.	32	32	9	50	Female
Elizabeth T.	46	48	10	61	Female
Margaret S.	36	35	9	49	Female
Susan S.	20	18	10	55	Female
Geraldine R.	30	29	17	116	Female

Table X.-
The Cultural Familial Control Group.

Subject	Initial I.Q.	Final I.Q.	Age	Weight (lbs.)	Sex
Dennis W.	61	62	12	86	Male
John T.	64	63	14	94	Male
Brian P.	66	64	15	118	Male
Lawrence P.	44	47	17	152	Male
Gregory P.	47	49	18	163	Male
George N.	56	58	18	153	Male
David L.	42	44	8	68	Male
Clarence H.	58	62	13	70	Male
John H.	48	46	13	78	Male
George H.	47	42	16	104	Male
Arthur B.	55	57	9	57	Male
Carolyn W.	43	44	10	88	Female
Mary U.	45	43	12	92	Female
Marlene M.	51	54	16	114	Female
Rosemary L.	38	37	12	131	Female
Harriet E.	59	56	13	125	Female
Ruth B.	43	43	15	116	Female

APPENDIX 2
A NEWSPAPER CLIPPING

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A NEWSPAPER CLIPPING

This article appeared as a United Press International release, sometime during the month of August 1962. Efforts to locate an exact reference to it, however, have proved fruitless, so a photostatic copy appears here, in lieu of the required reference.

'Lemonade' Proves Boon To Retarded

BRIGHTON, Eng (UPI)— Every morning, 80 backward youngsters at St. John's special boarding school here drink a glass of "lemonade" that may give them the chance of a normal life.

The children, ranging in ages from 8 to 11, are participating in the first large-scale test of a new drug which doctors hope will improve the speed of learning.

The pleasant tasting drink contains the drug dimethylaminoethanol—which is known in the United States as deaner. American doctors have found the drug makes children more relaxed and happier. An American 10 year-old boy's IQ rose from a very low rating of 40 to 80 in six weeks according to medical reports.

The tests have started seven weeks ago and teachers claim the results thus far are "encouraging."

School headmaster Chetwyn Butler said the parents of all the children involved in the experiment gave permission for the tests to continue. He said the children love the drink which they think is lemonade.

APPENDIX 3

ABSTRACT OF

The Influence of Dimethylaminoethanol (Deaner)
On The Psychometric Intelligence of
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Many studies have been conducted in the past with such chemical agents as Glutamic acid and Vitamin B compounds, in an effort to improve upon the present level of intelligence in retarded individuals. Recently, investigators have turned their interests toward a relatively new compound, Deaner. The few studies which have been conducted in this field, however, have failed to meet the stringent requirements necessary for good research. With the intention of overcoming these previous shortcomings, and attempting to supply an answer to the question: Does Deaner increase I.Q., the present study was undertaken.

Sixty retarded children, composed of Mongoloid and Cultural Familial subjects, were divided into two matched groups on the basis of I.Q., age, sex, weight, and etiology. The experimental group was given two hundred milligrams of Deaner daily, in two divided doses, and the control group was given matching placebos. After a period of eight weeks, both

1 Richard T. Paton, masters thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, December 1963, vii-81 p.

groups were re-tested with the Stanford-Binet Intelligence Scale (Form L-M). Differences in mean I.Q.'s were recorded and a statistical test of significance was made. This t test demonstrated a small but significant difference in mean I.Q. scores after drug administration in favour of the experimental group. The Mongoloid subgroup, however, showed no significant difference in psychometric intelligence, and it was concluded that the significant total score was composed almost exclusively from the Cultural Familial subgroup.

It had been previously postulated that attention span would increase after treatment with Deaner, but this was not demonstrated by the Stanford-Binet subtests which are capable of measuring this faculty. It was concluded that no one specific ability accounted for the slight increase in overall I.Q.

Very few behavioural changes were noted as a result of treatment with Deaner, but some experimental subjects were considered to be somewhat improved. Increased mental and physical alertness, and a more pleasant affect, were observed in most of these subjects.

From the results of this experiment, it was concluded that: Deaner did bring about small but significant increases in psychometric intelligence in the sample of Cultural Familial subjects. Because of this fact, the suggestion

was put forth that perhaps increased doses of Deaner over an extended period of time might bring about more highly significant results in this subgroup of retarded children. It was considered that any further attempts to increase the intelligence of Mongoloids with chemical agents would, no doubt, prove ineffective.

THE INFLUENCE OF DEANER ON THE
PSYCHOMETRIC INTELLIGENCE
OF RETARDED CHILDREN

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THE INFLUENCE OF DEANER ON THE
PSYCHOMETRIC INTELLIGENCE
OF RETARDED CHILDREN

INTRODUCTION

In 1958 a new psychic energizer was introduced by the Riker Pharmaceutical Company. This compound was the para-acetanidobenzoate salt of 2-Dimethylaminoethanol, and was given the proprietary name of Deaner. Many claims have since been made for this drug product, and many experiments have been conducted with it, particularly in an effort to reduce behavioural disorders in children. Attempts have also been made to increase the psychometric intelligence of retarded individuals with the daily administration of Deaner. Unfortunately, however, the previous studies in this latter field, have been poorly controlled, and as a result of this, it is difficult, if not impossible to arrive at any definite conclusions.

Pfeiffer and Murphree (1958) noted increased mental stimulation in their university student volunteers, after the administration of Deaner; but more specifically in the field of retarded children, Palmer and Wright (1958) considered, that in all eight of their subjects, an increase in attention span was produced.

Finlayson (1959) in a small study at Orillia, Ontario, concluded that the drug was not effective in the treatment of the mentally retarded child with schizophrenic or schizoid tendencies.

Okasaki (1960) in Japan, demonstrated that Dimethylaminoethanol produced significant differences on the Mental Work Process Analyzing Test, but no significant differences on intelligence tests or learning tests.

In a somewhat more carefully conducted study at Vineland Training School, Clausen et. al. (1960) were of the opinion that Deaner did not improve power of concentration or attention span in their mentally retarded subjects, but they felt that the drug may possibly have some effects which were not reflected in the scores of the objective tests.

In a large scale study on the effects of Deaner in children with behaviour disorders, Fields (1961) demonstrated an appreciable and significant increase in psychometric intelligence in a sample of ten children selected at random from his sample of four-hundred cases. He pointed out that the increment in level of improvement ranged from plus ten to plus thirty-four, with an average of 20.6 points increase in the intelligence quotient, above the subjects basal level.

In a more recent study, Bell and Zabek (1961) concluded that Deaner had an adverse or inhibiting effect on intellectual performance in adult defectives, as their placebo group gained 4.40 points on the full scale Wechsler I.Q. as compared to only 1.60 I.Q. points in the Deaner group.

However, due to the fact that the majority of these studies have been poorly conducted it is difficult to arrive at any definite conclusion, from an examination of their results. The question then: Does Deaner increase the I.Q. of retarded children? has not been adequately answered. It was therefore the purpose of this experiment, to supply an answer to the above question, and it is toward this end, that the experimental procedure has been directed.

Theoretically, one would expect a concomitant increase in psychometric intelligence after the administration of Deaner, as the drug is reputed to increase level of concentration and attention span. If attention span is indeed increased, then this heightened ability should result in an increased intelligence quotient, due to the fact that attention is an integral part of efficient learning. Partially for the purpose of testing this theory, and partly because of the difficulty which moderately retarded children have with some psychological tests, the Stanford-Binet (Form L-M) was used in this research.

Sixty Mongoloid and Cultural Familial retarded children between the ages of seven and twenty, were selected from the Ontario Hospital School at Cedar Springs. These children were tested by the writer with the Stanford-Binet, and were then divided into two matched groups, on the basis of: I.Q., age, sex, weight, etiology, and previous drug administration. Then in a carefully conducted double-blind study the experimental group, consisting of fourteen Mongoloids and fifteen Cultural Familial patients, was given two-hundred mg. of Deaner each day, in two divided doses, one at 8 a.m. and the other at 4 p.m. The control group was given matching placebos at the same times. This treatment continued for a period of eight weeks, at which time a second psychometric evaluation was conducted.

Throughout the period of drug treatment, all subjects were given an equal opportunity to improve their intelligence score, as members of both groups attended summer school, and participated in

recreation on the hospital wards. Weekly reports of any behavioural changes were gathered from the ward attendants at the beginning of each experimental week, and three weeks after the termination of the study.

At the close of eight weeks of treatment with drug and placebo, all subjects were tested again with the Stanford-Binet, under similar environmental conditions as existed at the first evaluation. These latter scores were compared with the original I.Q. figures, and comparisons were made between mean I.Q.'s of experimental and control groups, utilizing a statistical "t" test of significance between means. The results of this clinical trial are presented below.

RESULTS

After eight weeks of treatment with Deener, the experimental group experienced a mean gain of 1.69 I.Q. points, as compared to a loss of .10 I.Q. points in the control group. This difference of 1.79 was statistically significant at the two percent level of probability, for fifty eight degrees of freedom. The average I.Q. of the experimental group had risen from 41.79 before drug administration, to 43.48 after drug administration. However, upon closer inspection, it was discovered that this total significant increase, was comprised almost exclusively from the I.Q. scores of the Cultural Familial subjects. The Mongoloids did not show any significant increase in I.Q. after treatment with Deener, and in fact, this subgroup of experimental subjects dropped .14 I.Q. points on the average. In contrast to this however, the Cultural Familial subgroup produced considerably more encouraging results.

Prior to drug administration, the mean I.Q. of the Cultural Familial experimental group was 51.67, which rose to 55.07 after eight weeks of treatment. This increase of 3.40 I.Q. points, as compared to an increase of only .40 I.Q. points in the Cultural Familial control group, was definitely significant at the two percent level of probability.

A closer examination of those Binet subtests capable of measuring attention span, such as "Memory for Designs", "Digit Span", and "Memory for Sentences", did not point to any appreciable group increase in level of concentration. While attention span subtests did account for increased I.Q.'s in some cases, other subtests contributed to the elevated scores in other cases. No one type of subtest contributed significantly more than another.

In terms of improvements in behaviour, it was reported by the ward staff, that 38% of the experimental group experienced favourable changes. Increased mental and physical alertness, and a more relaxed and apparently happier nature, were observed in these subjects. However, similar improvements were also noticed in 13% of the control group subjects, after eight weeks of treatment with placebo tablets.

DISCUSSION

It is interesting to note that the above results are positive, only for the Cultural Familial subjects in this experiment. Apparently Deaner had no effect on the brain chemistry of the Mongoloids. Such results might possibly have been hypothesized from what is already known about Mongolism and Cultural Familial retardation. In the case

of the Cultural Familial retarded child, there is no evidence for organic brain damage, and therefore, any chemical agent such as Deaner, would be operating on an essentially normal brain structure. The diagnosis of familial retardation rests solely on the presence of mental deficiency in the family, where there is no evidence for any gross structural defect. Where Mongoloids are concerned, however, the situation is entirely different, as here there is a clearly demonstrable defect in brain chemistry. Autopsies have shown that the brain reveals a decelerated maturation, with severe degrees of cell degeneration. It is possible therefore, that Deaner simply does not function adequately in the presence of abnormal brain development. However, the comparatively positive results which were obtained with the Cultural Familial subjects points to further possibilities with this group of retarded children. It is quite possible that with an increased dosage of Deaner, administered over an extended period of time, more startling increases in psychometric intelligence might be forthcoming, in a sample of familial retarded children. It is doubtful, however, if any further attempts to increase the I.Q. of Mongoloids with psychotropic agents, would be significantly successful.

SUMMARY

In an attempt to study the influence of Deaner on the psychometric intelligence of retarded children, sixty children, classified as either Mongoloid or Cultural Familial, were tested with the Stanford-Binet Intelligence Scale (1960). The subjects were then divided into two matched groups on the basis of: I.Q., age, sex, weight, etiology,

and previous drug administration. The experimental group was given two-hundred mg. of Deaner daily, for a period of eight weeks, and the control group was given matching placebos. At the termination of the eight week period all subjects were again tested with the Binet, and it was found that the Cultural Familial experimental subjects had increased 3.40 I.Q. points on the average. This represented a statistically significant value at the .02 level of probability. No significant differences were obtained in the sample of Mongoloid retarded children. These results led to the conclusion that Deaner most likely does not affect the abnormal brain chemistry of the Mongoloid, but does produce some positive changes in the structurally normal brain of the familial retarded child.

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