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MENTAL DETERIORATION AND THE OTTAWA-WECHSLER

by Pascal Joseph Delli Colli

Thesis presented to the School of Psychology and Education of the University of Ottawa as partial fulfillment of the requirements for the degree of Doctor of Philosophy in Psychology.

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CURRICULUM STUDIORUM

Pascal Joseph Delli Colli was born on March 18th, 1930, at Montreal, Quebec. He studied at Loyola College in Montreal, and later attended St. Michael's College, Winooski Park, Vermont, where he obtained his Bachelor of Arts degree in the year 1954. The degree of Master of Arts in Psychology was conferred upon him in the year 1957 by the University of Ottawa. The title of the thesis was: A Study of the Rationale of the Wechsler-Bellevue Picture Arrangement Subtest, Form I.

TABLE OF CONTENTS

LIST OF TABLES

Table page

Table page

Table page

Table page

Table page

INTRODUCTION

The lack of definitive evidence regarding the topic of mental deterioration with age has resulted in the production of a large number of investigations since the mid-1870's. To this day, the question remains unresolved and is most probably due to the many different conclusions which have been drawn from studies which, for all practical purposes, yielded similar results. Some authors were in favour of accepting the idea that intelligence declined as age progressed while others were not so inclined. Still others were willing to compromise and they concluded to a differential decline of abilities rather than to an over-all decrement in intelligence especially as certain types of intelligence tests showed no losses in scores with age and sometimes even resulted in higher test scores.

The present author has undertaken to further investigate the problem in an attempt to clarify this issue by using a different approach. Generally, this study will be concerned with the investigation of the concept of differential mental deterioration and its relation to aging by dealing with test scores obtained on l'Echelle d'Intelligence Ottawa-Wechsler.

The first portion of the report presents the problem and a review of the general and more specifically

related literature, the latter being broken down into studies accepting the concept of mental deterioration as part of the aging process and those which reject it and offer alternative conclusions. From these various proposed solutions, the hypothesis of the present study is formulated. Chapter II furnishes the experimental design. A brief description of the Ottawa-Wechsler is presented and is followed by a discussion of the variables requiring consideration. The method of selecting the sample is outlined which leads to a description of the sample used. Some discussion is given to the statistical methods of analysis which were considered but rejected, to the final methods adopted and to the levels of confidence required to establish the statistical significance of the results obtained. The third chapter deals with the presentation and analysis of data. Thirteen parallel sections, though seemingly redundant, were included in order to present the large quantity of material more clearly. Summarizing tables are found in each of the sections. Conclusions are also reached which are further expanded upon in the following chapter. The last section of the study focuses upon the solutions submitted by past research and are integrated with the findings of the third chapter. A discussion of the six major conclusions presented in the literature is followed

by some discussion on the nature of mental deterioration.

Finally, a summary of the findings and conclusions reached in the present investigation is presented with suggestions for further research.

CHAPTER I

A REVIEW OF THE LITERATURE

The introduction has pointed out that the present report concerns itself with an investigation of differential mental deterioration with age. Stated in another way: is mental deterioration directly related to aging, or to other factors, or both; if so, is mental decline differentially affected? This, generally stated, is the problem.

In order to set the present undertaking in its proper perspective, it will be necessary to consider what both empirical and experimental evidence have revealed with respect to intellectual losses as a function of aging. Some have accepted mental decline as part of the aging process while others have refused to take this stand and have offered alternative hypotheses as well as substantiating evidence to explain what they consider an apparent decline which occurs concomitantly with advancing age. The review of the literature will therefore involve a general overview of reports which bear some indirect relationship to the present undertaking and those which are more directly concerned with the problem and have expressed definite viewpoints concerning mental deterioration. In the light of what has been accomplished

up to the present time, it will be possible to present a clear formulation of the hypothesis with which this report is concerned.

1. Survey of the Literature

a) General considerations.-- Since the first quarter of this century, researchers and theorizers have sought to determine whether mental deterioration was indeed a reality and whether, being a reality, it was a "normal" or an abnormal phenomenon which accompanied the aging process. If it were normal, it would be important to know how much of a decline could be expected as an individual grew older, whether this loss would hinder a person's performance and the extent to which it would do so. On the other hand, if intelligence were <u>not</u> itself affected, then how could this decline be accounted for?

From a perusal of the literature, the controversy appears to be as prevalent to-day as it was when the first considerations and investigations of the problem were undertaken. The question remains a complex and thorny one. As Litwinski so aptly expressed it:

> Le probleme du declin mentale montre des imprecisions dans sa maitrise scientifique. Il est vaste. Il concerne a la fois le domaine du mentale et du cerebrale, la nature de l'intelligence, et l'idee du declin.
>
> Quand it est question de ce dernier, on ne sait pas toujours de quel declin on parle. Est-ce l'affaiblissement vital, l'arret de

> developpement, l'extinction, le retrecissement ou l'indifference, la decheance organique ou celle de l'intellect, la regression intellectuelle ou affective, l'infantilisation ou autre chose encore dont il est question?[1]

Cattell's comments are also relevant:

> The age decline of intelligence in "speed" but not in "power" at once provokes a controversy on the meaning of intelligence... In short, the present status of adult intelligence testing cannot be meaningfully discussed without a considerable digression on theories as to the nature of intelligence.[2]

A few workers have at least made an attempt to define what they meant by intelligence or its decline, if only on an operational basis. Sorenson claimed that "Decline in ability has been interpreted as indicating a decrease in sheer capacity or basic intelligence. ...such reasoning is highly fallacious"[3]. Corsini and Fassett "regard intelligence as a within-the-skin entity which manifests itself by overt behaviour"[4]. Babcock held that mental

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1 Leon Litwinski, "L'Ascension et le Declin Mental en Fonction de l'Age", in Archives de Psychologie, Vol. 33, No. 129, issue of July 1950, p. 55.

2 R.B. Cattell, "The Measurement of Adult Intelligence", in the Psychological Bulletin, Vol. 40, No. 3, issue of March 1943, p. 157-158.

3 H. Sorenson, "Differential Effect of Age and Experience on Mental Abilities", in the Psychological Bulletin, Vol. 33, No. 9, issue of November 1936, p. 806.

4 Raymond J. Corsini and Katherine K. Fassett, "Intelligence and Aging", in the Journal of Genetic Psychology, Vol. 83, Second Half, issue of December 1953, p. 254.

deterioration "meant impairment of mental functioning with no implications as to possible causes, whether physiogenic or psychogenic..."[5]. A considerable amount of attention to the problem of deterioration was given by Wechsler who defined it as follows:

> By mental we shall mean primarily intellectual abilities, and by deterioration any conspicuous falling off or loss in these abilities. Consequently, a person will be considered as giving evidence of mental deterioration when he is no longer able to carry on his intellectual tasks with the speed, accuracy or efficiency previously characteristic of his functioning level.[6]

Lawton added to the complexity of the problem in concluding that

> We may sum up our discussion of mental functioning of old people by saying no adequate study of their mental abilities and performances yet exists. The first requisite for such a study is a satisfactory psychometric tool...
> .....
> But even when an adequate psychometric approach will have been devised it will have to be properly applied; i.e. the part the emotional, social and other non-intellective factors play in affecting test results must be suitably evaluated.[7]

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5 H. Babcock, "An Experiment in the Measurement of Mental Deterioration", in the Archives of Psychology, Vol. 18, No. 117, 1930, p. 5.

6 David Wechsler, The Measurement of Adult Intelligence, Third Edition, Baltimore, Williams and Wilkins Company, 1944, p. 54.

7 G. Lawton, "Mental Abilities at Senescence: A Survey of Present-Day Research", in the Journal of Applied Psychology, Vol. 22, No. 6, issue of December 1938, p. 618.

He[8] further complicated the issue by recommending that the term "retrogression" rather than "deterioration" be used to describe intellectual losses since the latter connoted disorganization and spoilage as well as permanence. He felt that retrogression would allow for a reversal of the trend. Returning to the first part of the above quotation, a partial answer was at least afforded by the appearance of the Wechsler-Bellevue Intelligence Scale for Adolescents and Adults[9], but the adult end of the Scale was criticized by Foster[10] because the weighted scores were based exclusively upon the standardization results of the 20 to 24-year-olds and, therefore, could not be interpreted directly when applied to the older groups. The second portion of the above statement was given some consideration by Wechsler:

> This does not mean that they [individual intelligence tests] are tests of personality but they do suggest that our intelligence tests contain elements which are essentially factors of the personality as a whole rather than specific cognitive abilities.

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8 G. Lawton, Chairman, "Psychological Problems of Later Maturity", in the American Journal of Orthopsychiatry, Vol. 14, No. 4, issue of April 1944, p. 267.

9 David Wechsler, The Wechsler-Bellevue Intelligence Scale for Adolescents and Adults, Record Form 1, New York, Psychological Corporation, 1947.

10 Austin Foster, "Age and the Wechsler-Bellevue Scattergraph", in the Journal of Clinical Psychology, Vol. 3, No. 4, issue of October 1947, p. 397.

> ...personality traits enter into the effectiveness of intelligent behaviour, and, hence, into any global concept of intelligence.
> .....
> My main point has been that general intelligence cannot be equated with intellectual ability, but must be regarded as a manifestation of the personality as a whole.[11]

However, these considerations do not show the extent to which the emotional, social, and other non-intellective factors affect test results, leaving the question unresolved. A further consideration was the establishment of a bridge between intelligence and age:

> ...It is possible to draw up tables of intelligence ratings and age as reported on the examination blank, to compute the regressions, and thus to determine the relation between age of officers or of men in the Army and their intelligence; but with the relationship once determined there is still no way of saying to what extent it reflects fundamental dependence of intelligence upon age or to what extent it may be caused by selective processes always at work in separating the Army from the population of the country.[12]

The literature has reported findings relating to the deterioration of a variety of psychological and physiological functions as measured by a number of devices and paper-and-pencil tests. The exceptions seem to have

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11 David Wechsler, "Cognitive, Conative and Non-Intellective Intelligence", in the American Psychologist, Vol. 5, No. 3, issue of March 1950, p. 82-83.

12 Robert M. Yerkes, Editor, "Psychological Examining in the United States Army", in Memoirs of the National Academy of Sciences, Vol. 15, Washington, Government Printing Office, 1921, p. 813.

been found in vocabulary and general information tests where little or no decline with advancing age, and indeed, even an increase in some cases, was reported.

To cite but a few studies which have dealt with these areas, Obrist[13] found that simple auditory reaction time increased differentially with age and also that reaction time variability became greater with age, indicating a differential rate of decline amongst old people. Kay[14], using sixty-four subjects aged 15 to 72 who were asked to carry out a problem-solving task whose difficulty could be varied by changing the position of an index in relation to a display control, reported that as difficulty or complexity increased, the older persons made considerably more errors. The writer feels that the continued inability of the older subjects to rid themselves of the wrong solutions was probably due to the fact that they were constantly informed of their errors which may have tended to frustrate them and to promote perseveration, impatience, and possibly unwillingness to co-operate.

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13 Walter D. Obrist, "Simple Auditory Reaction Time in Aged Adults", in the Journal of Psychology, Vol. 35, Second Half, issue of April 1953, p. 265-266.

14 H. Kay, "The Effects of Position in a Display upon Problem Solving", in the Quarterly Journal of Experimental Psychology, Vol. 6, 1954, as reported by J. Wayner, Jr., in the Psychological Abstracts, Vol. 29, No. 4, item 5278, issue of August 1955, p. 495.

Garfield[15], using vocabulary, found no deterioration and even a rise in test scores with increasing age. He explained that the increase could have been due to the sample which was a highly selected group both intellectually and educationally. Raven[16] obtained similar results with people of higher ability while Shakow and Goldman[17] found neither an increase nor a decline until the age of sixty years, with some evidence of loss after this age. In a comparative study of educated and working class women aged 25 to 50, Ehinger[18] found that a decline was apparent in both groups in four aptitude tests with slow decline in two tests. A group of High School students aged 16 to 20 years and one of normals aged 60 to 69 years, were asked to add single columns of numbers consisting of from two to twenty-five figures in a column.

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15 Sol L. Garfield and L. Blek, "Age, Vocabulary Level, and Mental Impairment", in the Journal of Consulting Psychology, Vol. 16, No. 5, issue of October 1952, p. 397.

16 J.C. Raven, "The Comparative Assessment of Intellectual Ability", in the British Journal of Psychology, General Section, Vol. 39, Part 1, issue of September 1948, p. 17.

17 D. Shakow and R. Goldman, "The Effect of Age on the Stanford-Binet Vocabulary Scores of Adults", in the Journal of Educational Psychology, Vol. 29, No. 4, issue of April 1938, p. 254.

18 G. Ehinger, "Declin des Aptitudes avec l'Age", in Archives de Psychologie, Vol. 23, No. 89, issue of April, 1931, p. 69.

Birren and Botwinick[19] found a rapid decline when the length of the column was increased. The young group declined to 50% correct while the older group declined to 35% starting to make errors with three numbers in a column until a difference of 8% was reached at fifteen numbers and of 15% at twenty-five numbers.

It might be mentioned in passing that there have also been a large number of studies reporting on mental deterioration indices which accepted the idea that intelligence declined with age. In addition, Payne[20] critically reviews numerous research reports which have dealt with deterioration in abnormal populations in terms of the functions which are affected. However, these will not be considered since they are not within the province of the present undertaking.

In summary, it could be said that studies on mental decline have rarely attempted to define intelligence or what was meant by deterioration. Apparently they accepted one of the many operational definitions

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19 J.E. Birren and J. Botwinick, "Rate of Addition as a Function of Difficulty and Age", in Psychometrika, Vol. 16, No. 2, issue of June 1951, p. 229.

20 R.W. Payne, "Cognitive Abnormalities", in H.J. Eysenck, Editor, Handbook of Abnormal Psychology: An Experimental Approach, New York, Basic Books, 1961, Chapter 6, p. 193-261.

or theories behind the intelligence tests they employed and then proceeded to investigate mental deterioration. An indication of the controversy concerning mental decline with age was presented along with a number of studies which showed a decline in performance and those which in some cases resulted in an increase in test scores.

b) Related research.-- Having reported on the more generally related investigations, those dealing more specifically with the problem will be considered. Two main divisions are evident:

i) intelligence itself deteriorates with advancing age; and

ii) deterioration is due to other factors.

The second can be elaborated further: deterioration is due to physiological and sensory changes; a differential decline of functions; disuse of capacities; and finally to non-intellective factors such as education, emotions, environment, and so on.

i) Intellectual capacity itself declines.-- With the advent of the Wechsler-Bellevue[21], a test constructed especially for the intellectual assessment of adults, since "up to very recently there has been no suitable

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21 David Wechsler, The Wechsler-Bellevue Intelligence Scale for Adolescents and Adults, Record Form I, New York, Psychological Corporation, 1947.

adult examination available"[22], came a little more confidence in the idea that

> The decline of mental ability with age is part of the senescent process of the organism as a whole. Hitherto, the common view has been that our mental abilities, unlike our physical abilities remain relatively unimpaired until rather late in life (senility), except as an occasional consequence of disease or traumatic injury. This was an unsubstantiated hypothesis tenable only so long as no facts were at hand to oppose it. But the view still persists even though such facts are now available.[23]

Presumably the "facts" to which he refers are drawn from his own findings and possibly bolstered by previous independent investigations using other measuring instruments.

Miles and Miles[24], with 823 subjects aged 7 to 94, used an abbreviated form of the Otis Self-Administering Intelligence Test, Superior, Form A. They found that after the twenties there is at first a slow rate of decline and then a more rapid drop in test scores.

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22 David Wechsler, The Measurement of Adult Intelligence, Third Edition, Baltimore, Williams and Wilkins Company, 1944, p. 15.

23 Id., ibid., p. 57.

24 Catherine Cox Miles and Walter M. Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity", in the American Journal of Psychology, Vol. 44, No. 1, issue of January 1932, p. 60.

The following year Jones and Conrad[25] published results which they obtained from their investigation of 1911 individuals, ranging in age from 10 to 60, using the Army Alpha. They showed a decline in test scores which by the age of 55 involved a recession to the fourteen-year-old level reaching a maximum somewhere between the ages of 18 to 21. They claimed that their results were consistent with findings reported for a variety of motor, sensory, perceptual and learning functions. Finally, Wechsler[26] reports having used a sample of 1751 individuals, aged 7 to 70, selected from a pool of 3499 records. The results were almost parallel to those of Miles and Miles[27]. It is rather striking that three major investigations, using different samples from three different areas, should have arrived at such similar results. With a sample of 7000 subjects aged 20 to 60, Vincent[28] found a linear

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25 H.E. Jones and H.S. Conrad, "The Growth and Decline of Intelligence: A study of a Homogeneous Group Between the Ages of Ten and Sixty", in Genetic Psychology Monographs, Vol. 13, No. 3, issue of March 1933, p. 239.

26 David Wechsler, The Measurement of Adult Intelligence, Third Edition, Baltimore, Williams and Wilkins Company, 1944, p. 103.

27 C.C. Miles and W.M. Miles, op. cit., loc. cit.

28 D.F. Vincent, "The Linear Relationship Between Age and Score of Adults in Intelligence Tests", in Occupational Psychology, Vol. 26, No. 4, issue of October 1952, p. 245.

decline in intelligence test score with advancing age.

Some of the more limited reports have also reported parallel findings. Howell[29], though interested in developing a better index of mental deterioration, used 397 subjects aged 20 to 89 and obtained results not unlike those of Wechsler, even though there was no mathematical relationship between the two methods of computing the curve of mental decline. Heston and Connell[30], with 643 subjects aged 15 to 76, found a rapid decline in three performance tests at the later ages, appearing first in the early thirties. Hanes, dealing with perceptual learning, stated that

> No evidence for any relationship between kinds of material and decline was found; but, rather a consistent relationship between age and performance was discovered. The younger person performs better, but experiences approximately the same difficulty with the various types of material as the older person.[31]

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29 Robert J. Howell, "Changes in Wechsler Subtest Scores with Age", in the Journal of Consulting Psychology, Vol. 19, No. 1, issue of February 1955, p. 50.

30 Joseph C. Heston, and Charles F. Connell, "A Note on the Relation Between Age and Performance of Adult Subjects on Four Familiar Psychometric Tests", in the Journal of Applied Psychology, Vol. 25, No. 4, issue of August 1941, p. 418.

31 B. Hanes, "Perceptual Learning and Age", in the Journal of Consulting Psychology, Vol. 17, No. 3, issue of June 1953, p. 224.

This could conceivably answer the objections which were raised by Lorge[32] and Hebb and Morton[33], among others, who have claimed that most intelligence tests are overloaded with tasks which are typical of the activities of young people, principally because these tests are standardized on these groups. On the other hand, in an investigation of younger and older workers, Brown and Ghiselli[34] have stated that where familiar materials and operations were involved, requiring neither precision nor complex processes, no differences existed when older and younger subjects were compared in speed tasks. However, the inferiority of the older groups was manifest in tasks which involved abstract and complex mental processes.

In a retest after an interval of ten years, Garrison[35] discovered that the younger subjects (below the age of thirty) gained on the average while the older

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32 Irving Lorge, "Intellectual Changes During Maturity and Old Age", in the Review of Educational Research, Vol. 14, No. 5, issue of December 1944, p. 438.

33 D.O. Hebb and N.W. Morton, "Note on the Measurement of Adult Intelligence", in the Journal of General Psychology, Vol. 30, First Half, issue of January 1944, p. 220.

34 C.N. Brown and E.E. Ghiselli, "Age of Semi-skilled Workers in Relation to Abilities and Interests", in Personnel Psychology, Vol. 2, No. 4, issue of Winter 1949, p. 497.

35 S.C. Garrison, "Retests on Adults at an Interval of Ten Years", in School and Society, Vol. 32, No. 819, issue of Saturday, September 6, 1930, p. 328.

group (over the age of thirty) lost. In contrast to this, some rather startling results were reported by Bentz[36] in a test-retest experiment. The most intelligent older group tended to show a decrease while a reversal of the trend for the less intelligent older group was discovered. However, one wonders whether this phenomenon was not an artifact.

Referring to the standardization of the W.A.I.S., Doppelt and Wallace[37] pointed out that performance measures showed a much greater decline than did the verbal measures. Foulds[38], while obtaining essentially the same results as the major investigations, found that the recall of information remained constant until the age of sixty. But Conrad[39] intimated that a rise on a test of information might in fact indicate a decline of intelligence since the increase observed may be smaller than that which should

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36 V.J. Bentz, "A Test-Retest Experiment on the Relationship Between Age and Mental Ability", in the American Psychologist, Vol. 8, No. 8, issue of August 1953, p. 320.

37 Jerome E. Doppelt and W.L. Wallace, "Standardization of the Wechsler Adult Intelligence Scale for Older Persons", in the Journal of Abnormal and Social Psychology, Vol. 51, No. 2, issue of September 1955, p. 330.

38 G.A. Foulds, "Variations in the Intellectual Activities of Adults", in the American Journal of Psychology, Vol. 62, No. 2, issue of April 1949, p. 245-246.

39 H.S. Conrad, "General Information, Intelligence, and the Decline of Intelligence", in the Journal of Applied Psychology, Vol. 14, No. 6, issue of December 1930, p. 599.

occur from the increased exposure to general information as age progresses.

Thus far only those studies which have reported losses and almost complete acceptance of the idea that intelligence does decline with age have been considered. Yet some authors have refused to accept mental deterioration as a fact even though their results were rather similar.

ii) Deterioration is due to other factors.-- Perhaps the most outspoken proponent of the concept of physiological breakdown and sensory changes was Irving Lorge[40], although earlier investigators had also concluded that intelligence itself does not actually decline with age but rather that the apparent loss was the result of the declining efficiency of the body as a whole.

In what could conceivably be considered a monumental work, Yerkes[41] reported the findings of an investigation of 15,385 white officers of the American Army aged from below 20 to over 60 years of age using the Army Alpha. The results indicated a decline in test scores with increasing age. He established that older men

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40 Irving Lorge, "The Influence of the Test Upon the Nature of Mental Decline as a Function of Age", in the Journal of Educational Psychology, Vol. 27, No. 2, issue of February 1936, p. 110.

41 Robert M. Yerkes, op. cit., p. 813-814 and 469.

obtained slightly lower scores than the younger but refused to accept as fact that intelligence declined, basing himself on his sample and the test used. He stated that although there was a certain form of random selection of subjects, this was not a random selection from the general population since some men were called to other specialized and armed services and others were rejected, thus affecting the probability of obtaining a general intelligence distribution. In terms of the test used he concluded that

> The interpretation of this tendency is another matter; it can not be said on the basis of the present information to point to a decrease of intelligence with age, or even to a decrease with age of the ability to succeed in the so-called 'speed-test' alpha.[42]

Thus, he refused to accept the idea that intelligence itself declined and some doubt has been cast by later researchers on the validity of the conclusions reached in other studies claiming deterioration.

Lorge[43] has consistently maintained that tests which have been used are a mixture of power and speed, where the speed requirements unduly penalized the older

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42 Robert M. Yerkes, op. cit., p. 814.

43 Irving Lorge, "The Influence of the Test Upon the Nature of Mental Decline as a Function of Age", in the Journal of Educational Psychology, Vol. 27, No. 2, issue of February 1936, p. 110.

individuals whose visual and auditory acuity, strength, speed of coordination and reaction have declined. He claimed that no deterioration was evident when power alone was considered. However, in answer to Lorge's frequent criticisms of the speed factor involved in tests of intelligence, Doppelt and Wallace[44], reporting on the standardization of the W.A.I.S., have demonstrated that little difference in scores existed between the test results when considered with or without a time limit. Nyssen and Delys[45] using the Progressive Matrices obtained similar results whether allowing for a twenty-minute time limit or for an indefinite period of time. Copeland[46], in a study of the relationship between speed and power and increasing age, found that speed declined in a linear fashion whereas power declined more slowly. In a test-retest investigation with the Army Alpha, Owens[47] found

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44 Jerome E. Doppelt and W.L. Wallace, op. cit., p. 329.

45 R. Nyssen and L. Delys, "Contribution a l'Etude du Probleme du Declin Intellectual en Fonction de l'Age", in Archives de Psychologie, Vol. 33, No. 132, issue of November 1952, p. 310.

46 Herman A. Copeland, "Age Differences in Mental Ability as Measured by a Work-Limit Test", in the Psychological Bulletin, Vol. 35, No. 9, issue of November 1938, p. 643.

47 W.A. Owens, "Age and Mental Abilities: A Longitudinal Study", in Genetic Psychology Monographs, Vol. 48, First Half, issue of August 1953, p. 45.

that in the 30 years from age 19 to 49 no significant decrease in test scores with advancing age and actually an increase on some of the tests was evident. He also provided for an over-time readministration of the test at the conclusion of the standard administration to allow for an analysis of the speed-power factors but the results showed no decrements. Although this study demonstrates no decline in scores, several criticisms could be levied against it. It could be argued that some of the subtests in which there is an increase are of the type which favour older subjects since these have had a longer exposure to this type of material. Secondly, if the peak of intelligence is reached at the age of 22.5 years[48] then the curve for ages 19 to 22.5 should increase. These tests showing no significant increases might actually have shown a decrease if compared to scores obtained at 22.5 years had they been available. Thus there could have been a rise from 19 to 22.5 years and then a decrease from the 22.5 to 19 year old level by the age of 49. Finally, the sample was a highly homogeneous and presumably intelligent group which would tend to influence the results in the direction of a gain rather than a decrease in test scores[49].

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48 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 41-43.

49 Sol L. Garfield and L. Blek, op. cit., p. 397.

Gilbert has attempted to introduce some order and more precision to the ideas on mental deterioration:

> In general, intelligence tests applied to persons in later maturity suffer from the fault of using an undifferentiated mixture of power and speed tests. This tends to obscure both the intellectual ability of the individual and the kind and extent of decline involved. Different abilities have different rates of growth and decline and speed tends to decline more rapidly than power. In other words, it is the efficiency rather than the intellectual phase of mental ability which shows the earliest decline.
>
> .....
>
> ...The causes of mental decline have not been certainly determined, but psychosomatic unity is so inherent in the human organism that there can be little doubt of the interdependence of physical, intellectual, and emotional factors... In short, it might be said that the reasons one person grows old at an early age while another remains young are probably a combination of heredity, environmental conditions, cultural influences, and life long physical, intellectual and emotional habits.[50]

To give further impetus to the idea that there is no decline of intelligence itself, a number of authors have introduced the concept of differential decline of functions. Gilbert[51] indicated that a decline in one function did not mean a loss in all others. Ruch[52]

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50 Jeanne G. Gilbert, "Measuring Mental Efficiency in Senescence", in the Journal of Orthopsychiatry, Vol. 14, No. 4, issue of April 1944, p. 268-269.

51 Id. ibid., p. 268.

52 F.L. Ruch, "The Differentiative Effects of Age Upon Human Learning", in the Journal of General Psychology, Vol. 11, No. 2, issue of October 1934, p. 284.

reported a differential deficit in learning ability as a result of age. Sorenson[53] showed that younger adults are better in some abilities while older adults are better in others, claiming that age and experience have a differential effect on abilities. In connection with this, Balinski[54], in a factor analysis of the various subtests for different age groups, discovered that the same test which is given to a young person may not be measuring the same factors as it might at the later ages. It could consequently be argued that if a person scores high on a test at a young age, he may score low on the same test at a later age because something different is being measured. This possibly could account for what appears to be a differential loss. Somewhat in the same vein, Eysenck[55] spoke of a dual differential decline, holding that different abilities decline at different rates and that the same abilities decline at different rates in different persons. These two central concepts would certainly affect

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53 H. Sorenson, "Differential Effects of Age and Experience on Mental Abilities", in the Psychological Bulletin, Vol. 33, No. 9, issue of November 1936, p. 806.

54 Benjamin Balinski, "The Analysis of the Mental Factors of Various Age Groups from 9 to 60", in Genetic Psychology Monographs, Vol. 23, First Half, issue of February 1941, p. 231.

55 Margaret Davies Eysenck, "The Psychological Aspects of Aging and Senility", in the Journal of Mental Science, Vol. 92, No. 386, issue of January 1946, p. 172.

the interpretation of loss in test scores in terms of either the same individual studied over a period of many years or of different persons being examined through a comparison of age groups. In an investigation of adult achievement in a sample of 1807 subjects aged 19 to 55 years and over, Osborne and Sanders[56] found a striking resemblance to the curve of decline of mental abilities where subjects such as Physics, Chemistry and Mathematics were concerned. But, Social Sciences, Fine Arts and Literature held up well with age. They therefore supported the hypothesis of a differential decrement with increasing age. One wonders whether any attempt was made to rule out the possible influences of educational and occupational levels, especially when considering the younger subjects who were presumably unemployed, still in the process of completing their formal education, and who had not yet attained a level comparable to that of the older individuals. Several other investigators[57] have also found this type of loss but using different kinds of samples.

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56 R.T. Osborne and W.B. Sanders, "Comparative Decline of Graduate Record Examination Scores and Intelligence with Age", in the Journal of Educational Psychology, Vol. 45, No. 6, issue of October 1954, p. 355 and 357.

57 G. Lawton, "Mental Abilities at Senescence: A Survey of Present-Day Research", in the Journal of Applied Psychology, Vol. 22, No. 6, issue of December 1938, p. 618.

R.J. Corsini and K.K. Fassett, op. cit., p. 261.

In an attempt to explain the differential rate of decline of abilities, the hypothesis has been put forth that this kind of decrement is due to disuse or lack of practice in using specific abilities. Although many investigations have pointed to the diminution of capacity to perform certain activities at later ages, Vernon[58] discovered that some decline was evident even in the late teens and concluded to the disuse of abilities. The less they are used the more quickly these abilities decline. The present writer feels that the same could be applied to the older age groups if this is true of the younger groups where development rather than decline should still be taking place. Sward[59] also maintained that the law of disuse was operative since the rate was more severely affected than was the quality of performance. Nevertheless he concedes there may have been some real residual decline over and above the lack of practice or interest. He also admits that this may be true of men who are endowed with superior intelligence, but what of those who do not fall in this category? Also employing a highly select sample,

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58 P.E. Vernon, "Changes in Abilities from 14 to 20 Years", in Advancement of Science, Vol. 5, No. 18, issue of July 1948, p. 138.

59 Keith Sward, "Age and Mental Ability in Superior Men", in the American Journal of Psychology, Vol. 58, No. 4, issue of October 1945, p. 478.

Sorenson[60] found that learning remained constant until the age of 50, and in another report[61] stated that deterioration was due to non-use of specific abilities as measured by the specific materials of adult intelligence tests. One wonders why he did not venture to conclude on the basis of vocabulary tests being the best single tests of general intelligence, that the intelligence of adults, or at least that those specific abilities which are used throughout an individual's life, should show a significant increase with advancing age. This same comment could apply to most investigations which have claimed that the actual loss in test scores was due to non-use of specific capacities rather than to a decline of intelligence. Three years later, Sorenson[62] confirmed his previous conclusions but stated that his findings did not necessarily indicate either a growth or a decline of basic capacity. Remarks made by Cattell are pertinent at this point:

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60 H. Sorenson, "Adult Ages As a Factor in Learning", in the Journal of Educational Psychology, Vol. 21, No. 6, issue of September 1930, p. 459.

61 -------- "Mental Ability over a Wide Range of Adult Ages", in the Journal of Applied Psychology, Vol. 17, No. 6, issue of December 1933, p. 736.

62 --------"Differential Effect of Age and Experience on Mental Abilities", in the Psychological Bulletin, Vol. 33, No. 9, issue of November 1936, p. 806.

> ...it seems likely that inequalities of test sophistication, if not of practice would be a more serious problem among adults, for older adults are more remote from the examination situation, emotionally resistant to it, uninterested in competition, less likely to be acquainted with the latest fashions in intelligence tests, and unused to working to brief limits.[63]

In addition to the idea of disuse of functions, several writers have claimed that a variety of other factors are responsible for the apparent decline of intelligence. Clay[64] discovered that there are changes with age in handling tasks of varying complexity. The manner of approach and the rigidity or inflexibility of the subject in dealing with the tasks were thought to be contributing factors in deterioration. In an investigation which ranks among the major works, Corsini and Fassett[65] used a sample of 1072 prisoners at San Quentin with 372 individuals above the age of 49. Their study revealed that two subtests showed a significant rise with age, three remained relatively constant, while all five performance subtests dropped significantly. In their considered opinion,

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63 R.B. Cattell, op. cit., p. 181.

64 H. Clay, "Changes in Performance With Age in Similar Tasks of Varying Complexity", in the British Journal of Psychology, Vol. 45, Part I, issue of February 1954, p. 12.

65 R.J. Corsini and K.K. Fassett, op. cit., p. 255-256 and 261.

> The most sensible conclusion is to declare that subtests are affected by various non-intellective factors, such as greater experience, education, visual loss, motor loss, and that as old people grow older these peripheral or non-pertinent factors act as artifacts which tend to distort test results.[66]

Their comments regarding other research findings are also relevant:

> We present as our hypothesis that intelligence does not decline significantly from early to late maturity, and that the decline noted by other investigators is mainly a function of two conditions: poor sampling, and the loading of non-intellectual factors in test scores.[67]

In the French standardization of the Wechsler-Bellevue Scale, Chagnon[68] showed that the Ottawa-Wechsler also revealed a decline in test scores with advancing age. Even when the scores were corrected for age, the curve still terminated in a decline. Nevertheless, he concluded that deterioration was not yet an evident fact, reiterating the arguments which have already been advanced above and adding that although sample populations may be representative of certain age groups they are not equivalent groups.

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66 Id., ibid., p. 262.

67 Id., ibid., p. 253.

68 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 37-50, passim.

Feifel[69] related mental deterioration to ego structure and the particular ways in which a person selects and organizes internal and external stimuli, thus involving the total personality. Lawton[70] was also concerned about the part played by social, emotional and other non-intellective factors. Rapaport et al.[71] have included other influences such as that of the home, region, country, profession, emotional or organic disturbances, which all interact to yield the test results obtained. Reisman[72] thought in terms of three types of aging people: those who remain themselves, create, and are very active; those who adjust; and those who are passive and decline.

To end on a somewhat discordant note, Feifel, reporting on the work of two neurophysiologists, stated that

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69 Herman Feifel, "Ego Structure and Mental Deterioration", in the Journal of Personality, Vol. 20, No. 2, issue of December 1951, p. 188.

70 G. Lawton, "A Long-Range Research Program in the Psychology of Old Age and Aging", in the Journal of Social Psychology, Vol. 12, First Half, issue of August 1940, p. 105.

71 David Rapaport, Merton Gill and Roy Schafer, Diagnostic Psychological Testing: The Theory, Statistical Evaluation, and Diagnostic Application of a Battery of Tests, Vol. 1, Chicago, Year Book Publishers, 1946, p. 37-38.

72 D. Reisman, "Some Clinical and Cultural Aspects of Aging", in the American Journal of Sociology, Vol. 59, No. 4, issue of January 1954, p. 383.

> They found little correlation between observed organic pathology and mental deterioration in the old and mentally impaired. Some patients who had presented rather profuse mental changes attributable to advancing years are reported to have shown little brain pathology at autopsy, whereas others with extensive cerebral lesions showed very good ability to adjust.[73]

The final word could perhaps be given to Litwinski:

> ...on peut concevoir l'infantilisation non pas comme une regression au sens d'une decadence mais, au contraire, comme un retour, un progres, un rajeunissement au meme titre que l'on approche le genie de l'enfance...
>
> Les individues, comme les peuples, sont capables de renaissance au cours de leur existence, de renouvellement de leur forces vitales. C'est ainsi qu'on parle d'une seconde jeunesse chez les individues...
>
> ...si l'individu eprouve des difficultes serieuses pour renaitre, il est d'avantage capable de se defendre contre la decheance prematuree grace aux substitutions, compensations, renovations, etc., aussi bien sur le plan physique que sur le plan psychique.[74]

Keeping in mind the reports which have been considered and the many different conclusions reached, the hypothesis of the present research must necessarily be limited to one or a combination of those already suggested. First there were two main divisions, one of which accepted mental deterioration as a result of aging, the other refusing to conclude to any real decline of

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73 Herman Feifel, op. cit., p. 169.

74 Leon Litwinski, op. cit., p. 55-56.

intelligence. Among the latter, a variety of suggestions have been expressed to explain the apparent losses which occur as a result of increasing age. Taking all these into consideration, it is hypothesized that test scores do not decline with age either generally or differentially when the influences of education, occupation and the degree of intelligence are held constant either singly or in various combinations.

The survey of the literature has attempted to show the imprecisions relating to differential mental deterioration with age as well as the complexity of the problem. A few generally related studies were cited giving rise to a divergence of opinion concerning mental decline. This was followed by more specifically applicable investigations which were categorized to show the two main trends: one which accepted mental deterioration as an inevitable part of the aging process while the second admitted to only an apparent decline as measured by various tests of intelligence. In an attempt to explain the loss in test scores, the reported decrements were ascribed to influences such as the physiological and sensory changes which accompanied the aging process, speed factors in test performance, differential rates of decline of abilities, disuse or lack of practice of specific abilities, the kinds of materials used in tests of intelligence,

rigidity of older subjects, greater experience, education, ego structure, occupation, and the kinds of samples used in attempting to determine the reality of a decrease in intellectual capacity. Finally, the literature gave rise to the hypothesis of the present research.

Having examined the literature in some detail and presented a workable hypothesis, the following chapter will consider the methods by which the problem will be investigated.

CHAPTER II

THE EXPERIMENTAL DESIGN

The review of the literature gave rise to the hypothesis to be investigated in this study. The present chapter will therefore deal with the approach which was to be used to investigate the problem. Consideration will first be given to a brief discussion of the choice and description of the measuring instrument which was to be employed to study the question of mental deterioration with age. This will be followed by a discussion of the variables which were to be considered, the selection of the sample, and finally, by a presentation of the statistical method of analysis.

1. The Measuring Instrument

The test which was selected to conduct this study was l'Echelle d'Intelligence Ottawa-Wechsler.[1] According to Chagnon[2], his study of the problem precluded the development of a theory of mental deterioration. The present author has undertaken to approach this question

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1 Maurice Chagnon, Manuel et Normes de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1953, 40 p.

2 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 49.

from a different point of view in the hope of arriving at some formulation regarding mental decline.

The Ottawa-Wechsler is a particularly suitable instrument since it was standardized on an adult population. It is also ideal in that it measures various functions, yields a verbal and performance score, and as such could be used to more adequately investigate the concept of differential decline with advancing age. A further advantage is that the original records used in the standardization of the test were available to continue the work begun with the development of the test.

The Ottawa-Wechsler is similar to the Wechsler-Bellevue[3] but differs in several respects: four of the verbal subtests were revised and standardized on a French Canadian population while the Chiffres and the five performance subtests are those of the Wechsler Scale except that these were also standardized on the same population[4]. The Ottawa-Wechsler consists of ten subtests each yielding a score, as well as composite scores resulting in a verbal, performance and total score. The five verbal subtests are: Renseignements, Cas pratiques, Chiffres, Arithmetique,

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3 David Wechsler, The Wechsler-Bellevue Intelligence Scale for Adolescents and Adults, Record Form I, New York, Psychological Corporation, 1947.

4 Maurice Chagnon, Manuel et Normes de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1953, p. 7.

Resemblances; the five performance subtests are: Series d'images, Images incompletes, Blocs a dessins, Objets defaits, Substitutions.

In terms of the way in which the test was to be used, the original data was to be employed as it was obtained, that is, according to the standard administration.

2. The Variables

The variables which were to be considered in undertaking the present study were those of age, education, occupation, sex, and intellectual functioning.

a) Age.-- Since this research is interested in the examination of mental decline and its possible association with aging, the age variable and its treatment becomes of considerable importance. The reason for this becomes clear when one considers that two different approaches have been employed or called for in the study of intellectual deterioration — the cross-sectional and the longitudinal. Practically all of the reports dealing with the problem have used the former method because of the obvious difficulties involved in carrying out a life-long research project. For this reason, as well as a practical one, the same procedure is to be followed in the present investigation of intellectual losses ascribed to the influence of age. The writer is well aware of the objections raised by

several authors. Chagnon[5] has said that age groups are not equivalent. Similarly, Feifel[6] has claimed that in comparing young individuals to old persons, the assumption that statistically significant differences obtained between the two groups are due to age is fallacious. Although Kuhlen was concerned with social changes accompanying increasing age, his point was well taken:

> Cross-section studies do give insight into age changes, but they make a more specific contribution to the understanding of age groups within the population than to the prediction of behaviour changes present-day youth will undergo.[7]

On the other hand, this investigator is also cognizant of the limitations of the longitudinal type of study as was pointed out by Anastasi and Foley[8].

In attempting to determine whether any relationship existed between age and test scores, other variables which could be thought to influence the results were to be taken into account. The following sub-sections will

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5 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 50.

6 Herman Feifel, "Ego Structure and Mental Deterioration", in the Journal of Personality, Vol. 20, No. 2, issue of December 1951, p. 191.

7 R.G. Kuhlen, "Social Change: A Neglected Factor in Psychological Studies of the Life Span", in School and Society, Vol. 52, No. 1332, issue of July 1940, p. 16.

8 Anne Anastasi and John P. Foley, Differential Psychology, New York, The Macmillan Company, 1949, p. 267-268.

therefore consider these areas.

b) Education.-- Reviewing those studies which have taken educational attainment into consideration, there have been indications that level of education has an influence on test results, especially in terms of increases in scores on particular examinations. Sorenson[9] found that where individuals were required to use verbal skills by virtue of their occupations, a rise on a test of vocabulary occurred up to the age of 70 years when holding education and occupation constant for those aged 25 years and over. One could argue that because all subjects had completed 12 to 14 years of education and were engaged in some type of verbal occupation, it would be difficult to establish whether the same trend would be evident in a heterogeneous group where the same influences would be held constant. It is hoped that this question may be answered by the present report. Garfield and Blek[10] also obtained similar results but feel that their study as well as others reporting increases could be due to the highly select type of samples used. Similar results were reported

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9 H. Sorenson, "Mental Ability over a Wide Range of Adult Ages", in the Journal of Applied Psychology, Vol. 17, No. 6, issue of December 1933, p. 736-738.

10 Sol L. Garfield and L. Blek, "Age, Vocabulary Level, and Mental Impairment", in the Journal of Consulting Psychology, Vol. [illegible], No. 5, issue of October 1952, p. 397-398.

by Corsini and Fassett[11] on the Information subtest of the Wechsler-Bellevue.

By contrast, Lorge[12] and Cattell[13] spoke of the remoteness from the school and examination situations which could account for a decline in test scores. This would lead the writer to conclude that the influences of formal education could affect test results.

In view of the differing conclusions it was felt that educational attainment should be taken into consideration in the present study.

c) Occupation.-- This variable has been given considerable attention in the first chapter where the advocates of the idea of disuse of functions claimed that this factor could be responsible for a loss in test scores with advancing age. Although it should be made clear at the outset that occupation is not necessarily related in all cases nor to the same degree, some relationship does exist between the level of occupation performed and

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11 Raymond J. Corsini and Katherine K. Fassett, "Intelligence and Aging", in the Journal of Genetic Psychology, Vol. 83, Second Half, issue of December 1953, p. 261.

12 Irving Lorge, "The Influence of the Test Upon the Nature of Mental Decline as a Function of Age", in the Journal of Educational Psychology, Vol. 27, No. 2, issue of February 1936, p. 110.

13 R.B. Cattell, "The Measurement of Adult Intelligence", in the Psychological Bulletin, Vol. 40, No. 3, issue of March 1943, p. 181.

intelligence.

Vernon[14] pointed out that a decrease in abilities occurs in men of lower occupational levels after the age of 17 years but that the level is maintained for those in more intellectually demanding work. Ball[15] found that those of lower intelligence would be employed at lower occupational levels and remain there while those of higher ability might begin at lower levels but would rise to better occupations. He goes on to say that level of occupation is not necessarily determined by intelligence but ability eventually does contribute, to a large extent, to level of occupation. Stewart[16] obtained similar results and also noted that persons obtaining high scores are found in the lower levels of occupation. It is obvious that what is necessary would be a breakdown of all occupations in terms of the specific functions demanded of an individual (such as verbal fluency, reasoning, and so on), with each occupation then being classified according to this system.

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14 P.E. Vernon, "Changes in Abilities from 14 to 20 Years", in Advancement of Science, Vol. 5, No. 18, issue of July 1948, p. 138.

15 R.S. Ball, "The Predictibility of Occupational Level from Intelligence", in the Journal of Consulting Psychology, Vol. 2, No. 6, issue of November-December 1938, p. 185-186.

16 Naomi Stewart, "A G C T Scores of Army Personnel Grouped by Occupations", in Occupations, Vol. 26, No. 1, issue of October 1947, p. 37.

Such an approach was suggested by Sorenson[17] whose sample included only subjects involved in some type of verbal occupation. However, this kind of job analysis would be difficult in terms of defining the functions being exercised as well as being a major undertaking. In any event, occupation was a factor meriting consideration.

d) Sex.-- Since the main interest has centred on the decline of functions with increasing age few studies have concerned themselves with the possible differences in losses between the sexes. In the standardization of the W.A.I.S., Doppelt and Wallace[18] reported that differences between the sexes were small enough to permit their combination, though this did not directly refer to intellectual decline. Miles and Miles[19], in a separate analysis, found a more rapid decline for women than for men. In the standardization of the Ottawa-Wechsler males and females were combined, all analyses being carried out

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17 H. Sorenson, "Mental Ability over a Wide Range of Adult Ages", in the Journal of Applied Psychology, Vol. 17, No. 6, issue of December 1933, p. 738.

18 Jerome E. Doppelt and W.L. Wallace, "Standardization of the Wechsler Adult Intelligence Scale for Older Persons", in the Journal of Abnormal and Social Psychology, Vol. 51, No. 2, issue of September 1955, p. 330.

19 Catherine Cox Miles and Walter M. Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity", in the American Journal of Psychology, Vol. 44, No. 1, issue of January 1932, p. 64.

on the total sample. Since there appeared to be little evidence concerning the influence of sex as an important variable in the study of mental decline and because the W.A.I.S. and Ottawa-Wechsler combined the sexes, a similar procedure was to be followed.

e) Intellectual Ability.-- Considering the work of Chagnon[20], level of intelligence is a factor which is worthy of attention. Studies which have dealt with highly homogeneous and comparative groups have also yielded similar results. Raven[21] found that ability to recall information varied with the level of intelligence. Below average subjects showed a slower increase in youth but an earlier decline; average individuals showed an increase to the ages of 25 to 27, remaining constant until about the age of 50, followed by some decline; above average people showed a greater increase in youth, a levelling off, and a slight increase to the age of sixty. Bentz[22], comparing high, average and low intelligence levels of a younger and

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20 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 45.

21 J.C. Raven, "The Comparative Assessment of Intellectual Ability", in the British Journal of Psychology, General Section, Vol. 39, Part I, issue of September 1948, p. 17.

22 V.J. Bentz, "A Test-Retest Experiment on the Relationship Between Age and Mental Ability", in the American Psychologist, Vol. 8, No. 8, issue of August 1953, p. 319-320.

older age group found a decline for the highly intelligent older group and an increase in the less intelligent older group in a test retest situation. He pointed out that the loss was a function of age, ability level, and the kind of ability measured. In the age group 60 to 69, Gilbert[23] reported that those of higher intelligence show less deterioration than those of lower capacities both in total average scores or on separate tests. Miles and Miles[24] discovered that the more intelligent and educated declined less than those of lower ability and less schooling. Similar results were obtained by Nyssen and Delys[25]. Using a sample of superior men, Sward[26] felt that there could be some real decline over and above that due to disuse. With a comparable type of sample, Garfield and Blek[27] also found an increase in score on a vocabulary test.

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23 J.G. Gilbert, "Mental Efficiency in Senescence", in Archives of Psychology, Vol. 27, No. 188, issue of July 1935, p. 23.

24 C.C. Miles and W.M. Miles, op. cit., p. 73.

25 R. Nyssen and L. Delys, "Contribution a l'Etude du Probleme du Declin Intellectuel en Fonction de l'Age", in Archives de Psychologie, Vol. 33, No. 132, issue of November 1952, p. 310.

26 Keith Sward, "Age and Mental Ability in Superior Men", in the American Journal of Psychology, Vol. 58, No. 4, issue of October 1945, p. 479.

27 Sol L. Garfield and L. Blek, op. cit., p. 397.

Unfortunately, level of intelligence can not be taken into account since this would result in small numbers in each category and would also produce difficulties in satisfying the requirements for a randomly selected stratified sample. It was thought, however, that if the obtained Intelligence Quotient were held constant in addition to the variables of education and occupation, any remaining relationship which might result between age and subtest or composite score could be attributed to aging and to uncontrolled and/or unknown influences.

The five subsections have attempted to point out the variables which for various reasons were to be taken into account. These were: age, education, occupation, and intellectual ability. Sex was not thought to be a contributing factor. The writer is well aware that there could be other elements operating which were not considered such as non-intellective factors, but it is to be assumed that these same influences are at work within each of the age groups. Exactly how the variables were to be treated will be taken up in section four. The following portion will now deal with the sample of this study.

3. The Sample

Before the sample could be selected, certain considerations emanating from the hypothesis as well as

from other sources had to be taken into account. Once these were established, the selection of the sample was to be undertaken according to specified principles. This is to be followed by a description of the resulting sample.

Because of the nature of the present investigation, the sample was automatically restricted to the so-called curve of mental decline. Thus, only subjects who were twenty years of age or over at the time of testing were to be employed. Keeping in mind Chagnon's[28] findings concerning the peak of mental growth, the age group 20 to 24 years was to be the lowest limit.

Many references have been made in the first chapter concerning the use and disuse of functions which have been thought to be responsible for the growth or the decline of abilities, respectively. Since this was thought to be a contributing factor, only those individuals who were employed at the time the tests were administered were to be included in the sample. Thus, lack of employment would not be permitted to operate and to possibly yield lower scores especially at the older age levels. Others who were still in the process of completing their formal schooling were to be considered unemployed and therefore not to be included. At the same time the further influence

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28 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 43.

of the educational factor would be eliminated since some authors[29] concluded that individuals in the younger age group who are still at school would tend to continue to show a rise in test scores.

A third limiting factor which was to be considered was that of the intelligence quotient. It was claimed by Sloan[30] that individuals of low intelligence may not have yet developed to the point where they would be considered to deteriorate. This would seriously affect the results of any study on mental decline. For this reason, individuals obtaining an I.Q. below 65 were to be eliminated from the sample.

Having considered the three restrictions which were to be imposed on the sample, attention may now be turned to the principles of selection.

The necessary data and pertinent information from 980 records having been transcribed, the pool was classified according to sex and into five age groups: 20 to 24; 25 to 34; 35 to 44; 45 to 54; 55 to 59. Each age and sex

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29 Irving Lorge, "The Influence of the Test Upon the Nature of Mental Decline as a Function of Age", in the Journal of Educational Psychology, Vol. 27, No. 2, issue of February 1936, p. 110.

R.B. Cattell, op. cit., p. 181.

30 William Sloan, "Validity of Wechsler's Deterioration Quotient in High Grade Mental Defectives" in the Journal of Clinical Psychology, Vol. 3, No. 3, issue of July 1947, p. 288.

group was then subdivided into seven occupational levels according to Goodenough's[31] classification. The individuals in each age and sex group were then to be assigned to these categories.

The next step involved the use of the Canadian Census[32] from which the figures for the Ottawa Valley French-speaking male and female employed population were obtained in order to determine the number of individuals required to represent each category within each age group. These will be found in Table I. The subjects were then selected at random from among each category in the pool of records to satisfy the requirements of representativeness.

With reference to subjects obtaining an I.Q. below 65, the majority fell in the unemployed group. Since only four individuals obtained results lower than I.Q. 65 in the two younger age groups, it was decided to leave these in the sample.

The final sample included 370 individuals. The description of the sample is given in Table III. It should be noted that in the age groups 35 to 44 and 45 to 54 two discrepancies exist between the number of cases required

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31 Florence L. Goodenough and John E. Anderson, Experimental Child Study, New York, The Century Co., Appendix A, p. 501-512.

32 Figures from the 1950 Canadian Census were obtained from the personal files of Dr. Maurice Chagnon.

Table I.- Percentage of Population and Number of Subjects Within Each Age Group Representing the Distribution of Males and Females in the Various Occupational Groups.

Sex and Occupational Groups	Age Groups									
	20-24		25-34		35-44		45-54		55-59	
	%	N	%	N	%	N	%	N	%	N
Males										
I	4.35	2	10.00	8	9.95	4	9.31	4	9.38	2
II	5.38	2	10.53	8	14.65	6	15.79	6	15.78	3
III	24.17	11	16.55	14	19.09	8	19.90	8	20.23	4
IV					.10		.17		.10	
V	54.56	24	46.08	40	40.87	17	39.81	15	37.02	6
VI	4.73	2	10.07	9	7.87	3	6.49	3	6.77	1
VII	6.78	3	6.66	6	7.48	4	8.52	3	10.72	2
Subtotals	99.97	44	99.89	85	100.01	42	99.99	39	100.00	18
Females										
I	2.76	1	6.57	3	2.01	1	7.67	2	6.61	1
II	.74	1	1.66	1	8.20	1	4.53	1	3.54	
III	40.42	19	36.98	18	30.93	5	23.00	7[a]	17.71	1
IV					.14					
V	54.20	26	52.56	25	53.42	14[a]	53.55	6	54.54	3
VI	.28		.41		.54		.67		1.06	
VII	1.59	1	1.82	1	4.75	1	10.57	1	16.53	2
Subtotals	99.99	48	100.00	48	99.99	22	99.99	17	99.99	7
Total N		92		133		64		56		25

a See text, pages 44 and 47.

Table III.- Means and Standard Deviations for the Four Variables Involved in Each Age Group and in the Total Sample.

Age Groups	Age		Education		Occupation		I.Q.	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.
20-24	21.7	1.5	11.1	2.5	4.2	1.3	101.9	15.0
25-34	29.1	3.1	11.1	2.8	4.1	1.6	104.1	17.5
35-44	38.7	2.6	11.2	3.4	4.2	1.6	105.4	19.9
45-54	47.6	3.0	9.9	4.3	3.8	1.6	105.4	15.6
55-59	57.3	2.4	8.0	5.0	4.0	1.8	100.7	17.9
20-59	33.6	11.0	10.7	3.4	4.1	1.6	103.8	17.2

and those selected from the pool of records. Upon randomly reselecting the appropriate number of individuals to represent these categories and comparing these to the larger group, no significant differences were found between the means of the two groups for any of the variables, individual subtests, composite scores and Intelligence Quotient. The resulting group may be considered as a randomly selected stratified sample of the male and female working French-speaking population of greater Ottawa beyond the age of twenty.

The two restrictions placed on the sample in no way imply that it is not representative of a specified population. Moreover, it is realized that some of the subjects who were eliminated, especially at the older age levels, may possibly have experienced a loss in abilities. However, since this problem could not be circumvented, it was thought better to eliminate them so that more confidence could be placed in whatever results would be obtained.

Attention has been given to the restrictions placed on the sample. Thus, only subjects who were 20 years of age and over, employed at the time of testing and who were not considered severe mental retardates were to be included. Tables were presented which described the requirements for a representative sample and the final composition of the group, respectively.

The sample having been selected, the next step will be to discuss the means by which the data was to be analysed.

4. Statistical Methods

A number of likely procedures presented themselves which could be used to investigate the problem of differential deterioration with age. Those which were rejected and the reasons for their elimination will be discussed. This will be followed by the method which was selected, together with a discussion of the treatment of the data and the formulae which were to be employed in the analysis. Finally, the criteria for determining statistical significance will be presented.

In studying the hypothesis, the approach which first suggested itself was that of analysis of variance in three dimensions. This refined technique would give rise to the interaction of variables which were thought to have some bearing on intelligence test scores as age progressed. Taken singly, these factors could possibly show little effect on test results, but if they were combined, a decided influence could likely become apparent. Unfortunately, this approach could not be used because the variables involved were highly correlated. This gave rise to impossible sampling requirements, leaving empty "cells"

in the analysis of variance technique. For example, one could not obtain the test results of a twenty-year-old male professional with grade school education who would be located in the below average range of intelligence.

A second possibility centred on the method of differences between means. This was not feasible because of the initial requirement for a randomly selected stratified sample of a given population. Individuals in one age group would have to be matched with subjects in the other age groups on the variables being considered. This would result in destroying the representative nature of the sample as well as in yielding a small number of individuals in each age group.

The third approach which was considered was that of multiple correlation. In solving for the multiple coefficient, the beta weights would determine the amount of variance contributed by each of the variables. The procedure would then be to compare the weights between and among the age groups in order to discover whether these influences produced the same effects in all the age groups. Conclusions would thus have been drawn indirectly from the analysis. This approach, however, was dropped in favour of the advantages afforded by the method which follows.

The technique which was finally adopted was that of partial correlation where the influence of each variable

could be held constant. This method resembles analysis of variance, in that the variables are being held constant in various combinations, as well as the difference between means technique, in statistically reducing all individuals to a common denominator with respect to the variables under consideration. There is also some similarity to multiple correlation except that the procedure seems to be reversed. With the present approach, each age group could be compared to each other with respect to the ten subtests, the Verbal, Performance and Total scores once the influence of the variables was removed. Similarly, the procedure could be followed for the total sample. Basically, the interest focuses on the total group. The age groups are to be studied only in retrospect in order to determine whether the same trends would be obtained as would be apparent in the total group which would not be possible from an examination of the latter alone. Where significant findings were obtained, some indication of their origin might be found in the age groups. The aspect of differential decline, if any, could also be observed within the total group as well as between and among age groups by comparison of the ten subtests and three composite scales.

The method of partial correlation permits the statistical control of variables. This raises the question of how the latter are to be treated. With respect to age,

the actual age (rounded figure) is to be used. Occupation is to be determined by seven levels. Intellectual functioning will be determined by the I.Q. obtained on the test. Education is to be considered in terms of the number of grades completed. An individual finishing grade eight in Ontario would be credited with eight years while one completing grade seven in Quebec would also be credited with eight years since both are considered equivalent by educational standards. This one year differential was to be added to all who received any number of years of education in Quebec thereafter. For those beyond High School, four years were to be added for obtaining a Bachelor's degree, two more years for a Master's and two years for a Ph.D.

One additional point which should be mentioned is that since the weighted scores were based on the total standardization population[33], it was thought that to use these would yield a somewhat confusing picture. Therefore, the raw scores obtained on the subtests and the three composite scores will be used.

Now that the preliminary considerations have been presented, the statistical procedures will be outlined.

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33 Maurice Chagnon, Manuel et Normes de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1953, p. 23.

The first step will be to establish whether there is a decline in test scores for each subtest and composite scale by comparing the means of the 20 to 24 and the 50 to 59 age groups. This will be determined by means of the formula:

$$t = \frac{M_1 - M_2}{\sigma_{D_M}} .$$

In order to compute partial correlations, Pearson product-moment coefficients are required. Furthermore, in working out simple correlations, two conditions must be met: homogeneity of variance and linearity of regression. To ascertain whether these conditions are present, Dayhaw Correlation Charts[34] will be used. Once it is established that these correlations may be employed, they will be computed again by means of the raw score formula given below. The coefficients will be calculated for the total sample and for each of the five age groups. This will result in correlation matrices which will permit the development of partial correlations for the total sample and for each age group.

With respect to partial correlations, these will be worked out between age and each of the subtests and composite scores holding education, occupation and I.Q.

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34 Lawrence T. Dayhaw, Fiche de Correlation Dayhaw, Ottawa, Les Editions de l'Universite d'Ottawa, 1956.

constant for the total group and will be repeated for each age group eliminating the influence of the same variables. The formula used in developing partials will be found below.

The computation of simple correlations was to be performed by means of the raw score formula:

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\left[N\Sigma X^2 - (\Sigma X)^2\right]\left[N\Sigma Y^2 - (\Sigma Y)^2\right]}} .$$

Partial correlations were to be found by using the general formula:

$$r_{y1.23\ldots m} = \frac{r_{y1.23\ldots(m-1)} - r_{ym.23\ldots(m-1)}\ r_{1m.23\ldots(m-1)}}{\sqrt{\left[1 - r^2_{ym.23\ldots(m-1)}\right]\left[1 - r^2_{1m.23\ldots(m-1)}\right]}} .$$

In order to solve for partials to the third order, first, second and third order partials were to be developed by using the following:

a) First Order:

$$r_{y1.2} = \frac{r_{y1} - r_{y2}r_{12}}{\sqrt{\left[1 - r^2_{y2}\right]\left[1 - r^2_{12}\right]}} ;$$

b) Second Order:

$$r_{y1.23} = \frac{r_{y1.2} - r_{y3.2}r_{13.2}}{\sqrt{\left[1 - r^2_{y3.2}\right]\left[1 - r^2_{13.2}\right]}} ;$$

c) Third Order:

$$r_{y1.234} = \frac{r_{y1.23} - r_{y4.23}r_{14.23}}{\sqrt{\left[1 - r^2_{y4.23}\right]\left[1 - r^2_{14.23}\right]}} .$$

The symbols or subscripts y, 1, 2, 3 and 4 represent age, any subtest or composite scale, education, occupation, and I.Q., respectively.

Before being able to determine which results will or will not be statistically significant, fiducial limits must be established. For the present study, only those results which are at or beyond the 1% level of confidence will be considered significant. Those which are at or between the .05 and .02 levels will be considered only as approaching significance.

The two general formulae which will be used to establish the significance of the final results — one assuming coefficients of zero, the other using the obtained correlations — are:

a) For a Pearson:

$$\sigma_{r_o} = \frac{1}{\sqrt{N - 1}} ;$$

$$\sigma_r = \frac{1 - r^2}{\sqrt{N - 1}} ;$$

b) For a partial:

$$\sigma_{r_{oy1.23\ldots m}} = \frac{1}{\sqrt{N - m}} ;$$

$$\sigma_{r_{y1.23\ldots m}} = \frac{1 - r^2_{y1.23\ldots m}}{\sqrt{N - m}} .$$

These have been incorporated because they are commonly used. However, a more stringent test for significance will be applied for partial coefficients, namely:

$$F_{r_{y1.23\ldots m}} = \frac{r^2_{y1.23\ldots m}}{(1 - r^2_{y1.23\ldots m})/(N - m)} .$$

In presenting the experimental design, this chapter briefly considered the measuring instrument selected for the study of the problem of differential decline of test scores with advancing age. Attention was given to the variables which were thought to be contributing influences while recognizing that other unknown or unmeasurable factors could be operating as well. The procedures used in selecting the sample and the restrictions imposed on it were followed by a description of the resulting sample. A fourth section

dealt with the various statistical methods which were eliminated for one reason or another in favour of the technique of partial correlation. Mention was made concerning the use of raw scores rather than weighted scores and how the data was to be treated. Finally, the statistical formulae for assessing differences between means, and for computing Pearson coefficients and partial correlations were included together with those for tests of significance.

The conclusion of the experimental design now leads to a presentation and analysis of the results. These follow in the next portion of the report.

CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

The foregoing chapter has outlined the procedure which will be followed in the presentation and analysis of results. Two aspects will be considered: the decline in test scores established on the basis of differences between the means of the youngest and oldest age groups for each of the subtests and composite scales, and, the obtained partial correlations with references being made to Pearson coefficients in order to establish any apparent trends. Where indicated, reference will also be made to results obtained within the age groups.

Because the raw data is bulky and unweildy, it will not be included in the Appendix. Rather, since the data was obtained from readily accessible original records, the code number[1] of each subject will be listed in Appendix I.

This chapter will be organized into thirteen sections, each dealing with one of the subtests and each of the composite scales. The data obtained from 370 records will be summarized in tabular form where the number of individuals, the range, means and standard deviations of

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1 The corresponding code numbers will be found written and circled in green ink in the upper left hand corners of the original records.

raw scores for the various age groups and the total sample will be found. Tests of significance for the differences between the means of the 20 to 24 and 55 to 59 age groups as well as between the group with the highest mean and that of the oldest group will be presented to show whether any decline in test scores was evident for each section.

Other calculations which were required involved Pearson correlations. These and their corresponding standard errors were computed among the variables of education and occupation and between the latter and each of the subtests and composite scales for the total sample and for each age group. The simple coefficients were to serve in the development of first and second order partial correlations.

In order to save unnecessary labour, only those relationships which were to enter into the computation of partial correlations were to be checked for homoscedasticity and linearity of regression.

One hundred and twelve Dayhaw Correlation Charts[2] were developed. In all but two cases, the F test for linearity was considered to be not significant or only to be approaching significance (5%). In some cases it was found that in predicting X from Y the relationship was

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2 Lawrence T. Dayhaw, Fiche de Correlation Dayhaw, Ottawa, Les Editions de l'Universite d'Ottawa, 1956.

significantly different from linearity, whereas a linear relationship existed in predicting Y from X. With reference to the two Charts where neither were considered to be linear, the first resulted in a correlation of -.21 and an eta of .32 while the second showed a correlation of .53 and an eta of .56. In the first case, where the relationship between age and education for the total sample was sought, a large cluster of tallies was found in the younger age groups (20 to 39) in the average range of education (grades 8 to 13). This phenomenon seems to represent a fairly accurate picture of the present educational status of the population being investigated. In the second instance, where the correlation between the Renseignements subtest and occupation for the total group was required, a concentration of tallies was found in the third and fifth occupational levels, the latter including almost twice as many individuals as the former. Since these findings seem to adequately represent the actual status of the general population it was decided to proceed as if the obtained correlations were reliable even though they are actually underestimates of the relationships involved.

Having established that the Pearson correlations were to be used as they were obtained, partial coefficients were developed to the first, second and third orders.

It had been planned to present third order partial correlations where the influences of education, occupation and I.Q. would be controlled but this aspect of the study was eliminated because of the difficulty of interpreting these partials. Since the I.Q.'s were based on the test used in this investigation and obtained from the same raw scores which contributed to the development of I.Q.'s it seemed impossible to trace the part played by these raw scores and thus to give an adequate and meaningful explanation of the resulting third order partial. Furthermore, there are no statistical formulae which permit a direct comparison between Pearson and partial correlations and between partials when these have been derived from scores obtained on the same test by the same individuals. Therefore, all comparisons which will be made between Pearson and partial relationships or between first and second partials can only indicate trends through changes in levels of statistical significance, unless most of the variance has been explained through the control of variables. A resume of these may be found, where applicable, in the thirteen sections which follow in which Pearson and partial correlations and their corresponding standard errors are presented for the total sample. The first order partials refer to the relationship between age and subtest scores with the influence of education and

that of occupation being held constant, while the second order partial removes the effects of both education and occupation. These relationships were tested for significance by means of the F test and indications are given in the table footnotes as to the levels of significance.

Pearson correlations which are not directly related to the discussion of results have been relegated to Appendix II along with all other coefficients which served in the computation of other analyses.

It is planned to discuss each subtest and composite scale with reference to differences between the means of the 20 to 24 and 55 to 59 groups and between the highest mean and that of the oldest group. When these differences do not meet the required level of significance of 1%, Pearson and partial correlations will be found in tabular form in Appendix III, similar to those included in some of the sections below. These have been appended for the reader who might be interested in those subtests which show no significant differences between the means of the youngest and oldest group or between the highest mean and that of the oldest subjects. Further analyses were also carried out when significant differences between means were found. Tables of Pearson and partial correlations showing the results obtained by the five

age groups will be presented in order to determine whether any particular group contributes to the results obtained by the total sample.

Having completed the preliminary considerations, attention will now be focused upon the individual subtests and composite scales.

1. Renseignements

The results obtained on the Renseignements subtest will be found in Table IV. When the means of the 20 to 24 and 55 to 59 age groups were compared, a C.R. of 1.50 was obtained which does not reach the required 1% level of significance. The means continue to increase and to be at the highest level for the 35 to 44 group. If this were taken as the peak of development for this subtest, a comparison of this mean with that of the oldest age group would yield a C.R. of 2.0 which is significant at the 5% level of confidence.

Although there appears to be no loss in scores with advancing age, it would seem that were the trend projected beyond the age of 59 a significant decrement would be obtained. However, since the difference does not reach the required significance level of 1%, it can only be concluded that Renseignements scores do not significantly decline with age.

Table IV. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Renseignements Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	3 to 25	12.9	5.3
25 to 34	133	2 to 24	13.6	5.4
35 to 44	64	3 to 25	14.1	5.4
45 to 54	56	2 to 25	13.2	6.3
55 to 59	25	2 to 24	11.0	6.8
20 to 59	370	2 to 25	13.2	5.7

Since the other analyses which were conducted do not apply, the reader is referred to Appendix III, Table XXXVIII.

2. Cas Pratiques

The results obtained by the sample are presented in Table V. From the youngest to the oldest group there is a consistent downward progression of the means, superficially indicating a decline in Cas pratiques scores with increasing age. In assessing the means of the 20 to 24 and 55 to 59 age groups, however, no significant difference was found since a C.R. of 1.15 was obtained. The scores on this subtest are therefore considered to remain rather stable as age progresses.

Other analyses which were carried out will be found in Appendix III, Table XXXIX.

3. Chiffres

Table VI shows the results obtained by the sample on the Chiffres subtest. The means continue to show a rise and to reach their height at the 35 to 44 age group. When the means of the 20 to 24 and 55 to 59 groups were compared, the difference between them was not statistically significant (C.R. of 1.76). On the other hand, a C.R. of 2.33, significant at the .05 level of

Table V. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Cas pratiques Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	3 to 19	10.9	3.2
25 to 34	133	2 to 18	10.7	3.5
35 to 44	64	2 to 17	10.3	3.5
45 to 54	56	1 to 19	10.4	3.6
55 to 59	25	4 to 17	9.9	3.9
20 to 59	370	1 to 19	10.6	3.5

Table VI. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Chiffres Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	7 to 16	10.9	1.9
25 to 34	133	5 to 17	11.0	2.2
35 to 44	64	7 to 17	11.3	2.2
45 to 54	56	6 to 15	10.6	1.9
55 to 59	25	6 to 15	9.9	2.6
20 to 59	370	5 to 17	10.9	2.1

probability, was obtained when comparing the 35 to 44 and 55 to 59 age groups.

On the basis of present results it cannot be concluded that there is a decline in scores on the Chiffres subtest, but it might be said that a trend is evident which might become significant beyond the age of 59.

The reader is referred to Appendix III, Table XL for additional information which is not directly applicable here.

4. Arithmetique

The results obtained on the Arithmetique subtest may be found in Table VII. A cursory examination reveals that the means continue to rise and to reach a plateau from the ages of 25 to 44, with little decline in the next group, followed by a more severe loss in the oldest subjects.

A comparison of the means of the 20 to 24 and 55 to 59 groups demonstrated a difference approaching significance with a C.R. of 2.43. When the mean of the 35 to 44 age group was compared to that of the oldest subjects, a C.R. of 2.69 was obtained, significant at the 1% level of confidence. Because a trend was evident between the youngest and oldest subjects and since a significant difference existed between the highest mean and that of the oldest group, other analyses were performed.

Table VII. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Arithmetique Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	1 to 12	7.6	2.2
25 to 34	133	2 to 12	7.9	2.3
35 to 44	64	1 to 12	7.9	2.6
45 to 54	56	2 to 13	7.8	2.6
55 to 59	25	0 to 12	5.8	3.5
20 to 59	370	0 to 13	7.6	2.5

Table VIII reveals that when education alone or education and occupation are held constant, the negative Pearson coefficient, significant at 5%, is reduced to zero or nearly so, and that these variables explain all of the variance for this subtest. However, holding occupation alone constant resulted in a significant but negative relationship indicating a decrease in Arithmetique scores with increasing age. Occupation, therefore, tends to contribute to the maintenance of higher scores with age while the lack of education or insufficient schooling tends to cause the decrease of scores with age. On the basis of the results of the Arithmetique subtest, it cannot be said that intelligence declines with age since all of the variance has been explained by the variables of education and occupation.

Table IX presents a breakdown of the relationships found in the individual age groups which contribute to those obtained by the total sample. In the two younger and two oldest groups the coefficients did not reach the required level of significance. But a negative Pearson correlation, significant at 1% was found for the 39.5 group indicating a loss in Arithmetique scores within the group. Even when the influences of education alone or of education and occupation were nullified, significant relationships were maintained. Just what the implications

Table VIII. - Pearson Coefficient between Age and Arithmetique Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.12[b]	.05
$r_{y1.2}$	.00	.05
$r_{y1.3}$	-.17[c]	.05
$r_{y1.23}$	-.03	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

c Significant at 1%.

Table IX. - Pearson Coefficients between Age and Arithmetique Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.02	.10	-.14	.10	-.14	.10
29.5	-.02	.09	.01	.09	.01	.09
39.5	-.38[c]	.11	-.33[c]	.11	-.33[c]	.12
49.5	-.07	.13	-.01	.14	.03	.14
57.5	-.03	.20	-.26	.19	-.26	.20

c Significant at 1%.

are is not clear except that other factors could be operating and these were not accounted for. It would seem, however, that the correlation for this group contributed to that of the total sample in such a way as to yield the simple correlation of -.12 significant at the 5% level of confidence.

5. Resemblances

Table X shows the results obtained by the sample on the Resemblances subtest. The Table reveals that the highest mean is obtained by the 25 to 34 age group and the means then begin to progressively decline. When the 20 to 24 and 55 to 59 group means were compared, a C.R. of 2.39, significant at 5%, was found. Similarly, when the 25 to 34 group was compared to the oldest subjects, a C.R. of 2.56 was just short of significance at 1%.

The conclusion must necessarily be limited to the results, but it is likely that if the findings were projected beyond the age of 59 some loss would be evident.

Other statistical analyses which were carried out have been included in Appendix III, Table XLI.

6. Series d'Images

The results obtained by the sample are summarized in Table XI. An almost consistent decrease in means is

Table X. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Resemblances Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	2 to 20	11.1	4.1
25 to 34	133	1 to 21	11.5	4.7
35 to 44	64	4 to 20	11.0	4.2
45 to 54	56	3 to 19	10.1	4.5
55 to 59	25	3 to 19	8.5	4.9
20 to 59	370	1 to 21	10.9	4.5

Table XI. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Series d'images Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	2 to 20	11.7	3.9
25 to 34	133	3 to 21	11.5	3.5
35 to 44	64	4 to 19	10.7	3.3
45 to 54	56	4 to 18	10.8	3.5
55 to 59	25	2 to 17	8.3	4.0
20 to 59	370	2 to 21	11.1	3.7

observed for Series d'images scores with the exception of the 35 to 54 groups where a plateau is established. Upon evaluating the difference between the means of the youngest and oldest subjects, a C.R. of 3.80, significant beyond the 1% level of confidence, was obtained.

Because of the significant difference found which shows a decrement in test scores with advancing age, other analyses were carried out in an attempt to explain this discrepancy. The Pearson and partial correlations are presented in Table XII. When the influence of education was held constant, the Pearson coefficient, significant at 0.1%, only approached significance at 5%. This change in confidence level indicates that the lack of education or of sufficient schooling leads to a decrease in Series d'images scores with age which tends to explain a good deal of the variance. But when the influence of occupation is removed, the partial correlation becomes significant at 0.1%. Occupation thus tends to compensate for what would otherwise be a severe decline in scores with age on this subtest. Removing the influence of both variables results in a partial significant at the 1% level of confidence.

Since education and occupation exert some influence on the decline of scores, other variables which are specific to the test itself are likely responsible for the decline in scores.

Table XII. - Pearson Coefficient between Age and Series d'images Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.20[d]	.05
$r_{y1.2}$	-.13[b]	.05
$r_{y1.3}$	-.22[d]	.05
$r_{y1.23}$	-.14[c]	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

c Significant at 1%.

d Significant at 0.1%.

Tracing these results back to the age groups, Table XIII shows that none of the coefficients reach the 1% level of significance. The Pearson correlation in the 39.5 group, approaching significance at 5%, was no longer significant at this level when the influences of education or of education and occupation were nullified. Since no significant results were found, there would appear to be no losses in test scores with age within the age groups. Thus, it is likely that other factors are contributing to the remaining variance in the total sample.

7. Images Incompletes

The results obtained on this subtest are described in Table XIV. No definite trend in the means can be established but it appears that there is an increase to the ages of 25 to 34, followed by a plateau to the ages of 45 to 54, and finally a decrease. When assessing the difference between the means of the 20 to 24 and 55 to 59 age groups, a C.R. of 2.42, significant beyond 5%, resulted. Upon comparing the means of the 45 to 54 group with that of the oldest subjects, a significant C.R. of 2.75 was obtained.

Because a trend toward a decline in the first comparison and a significant difference existed between the means of the two oldest groups, the results were

Table XIII. - Pearson Coefficients between Age and Series d'images Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.10	.10	-.02	.11	-.02	.11
29.5	-.04	.09	-.03	.09	-.02	.09
39.5	-.29[b]	.12	-.23	.12	-.23	.12
49.5	-.03	.13	.02	.14	.04	.14
57.5	.14	.20	.01	.21	.02	.22

b Significant at 5%.

Table XIV. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Images incompletes Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	6 to 15	10.8	2.4
25 to 34	133	4 to 15	11.0	2.5
35 to 44	64	3 to 15	10.9	2.7
45 to 54	56	2 to 15	11.1	2.5
55 to 59	25	4 to 14	9.2	3.0
20 to 59	370	2 to 15	10.8	2.6

further examined and are presented in Table XV. The Pearson correlation of -.09 was not considered to be significant and with the removal of the influence of education it was reduced to zero. Again, nullifying the influence of occupation resulted in a negative partial significant at 5%, indicating that this factor tends to prevent a loss in scores with age. The removal of both variables yielded practically no correlation. Therefore, since all of the variance has been explained, it can be concluded that intelligence, as measured by this subtest, does not decline with advancing age.

A further analysis of the results in terms of age groups is presented in Table XVI. None of the relationships in the two younger and two oldest groups reach the required level of significance of 1%. But, the 39.5 group reveals a significant simple correlation which remains at that level even when the influences of education or of education and occupation are controlled. There is thus a decrease in test scores with age within the group itself on Images incompletes. The implications of these findings are not clear but it would appear that certain other elements could be operating within the group to yield these results. If any decline in scores were evident for the total sample it would emanate from this group. However, a Pearson of -.09 was obtained which was not

Table XV. - Pearson Coefficient between Age and Images incompletes Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.09	.05
$r_{y1.2}$	.00	.05
$r_{y1.3}$	-.11[b]	.05
$r_{y1.23}$	.01	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

Table XVI. - Pearson Coefficients between Age and Images incompletes Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.18	.10	.08	.11	-.08	.11
29.5	.06	.09	.09	.09	.09	.09
39.5	-.42[c]	.10	-.38[c]	.11	-.38[c]	.11
49.5	-.24	.13	-.21	.13	-.20	.13
57.5	.22	.19	.12	.21	.12	.22

c Significant at 1%.

considered as being significant. It may then be safely concluded, on the basis of the sample and age group results, that intelligence does not decline with age as measured by Images incompletes.

8. Blocs a Dessins

The results obtained by the sample on the Blocs a dessins subtest are summarized in Table XVII. The highest mean is observed in the 25 to 34 age group and a consistent decline is noted thereafter. In assessing the difference between the means of the 20 to 24 and 55 to 59 groups, a C.R. of 1.96 is obtained which is significant at the .05 level of probability. If the 25 to 34 age group is compared to the oldest subjects, a C.R. of 2.11 results and remains significant at the same level. Were this situation projected beyond the age of 59 it is likely that further losses would occur. However, basing the conclusions on the results, it may only be said that there is a trend toward a decrement in test scores with increasing age.

Since the results were inconclusive, other computations have been included in Appendix III, Table XLII.

9. Objets Defaits

Results obtained on the Objets defaits subtest are summarized in Table XVIII. A glance at the means shows a

Table XVII. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Blocs a dessins Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	9 to 37	23.9	6.5
25 to 34	133	9 to 42	24.3	6.3
35 to 44	64	6 to 39	22.6	6.6
45 to 54	56	6 to 38	21.5	6.6
55 to 59	25	3 to 40	19.8	9.7
20 to 59	370	3 to 42	23.2	6.9

Table XVIII. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Objets defaits Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	6 to 25	19.4	3.4
25 to 34	133	9 to 25	19.7	2.7
35 to 44	64	12 to 24	19.6	2.7
45 to 54	56	5 to 22	18.1	3.2
55 to 59	25	6 to 21	16.4	4.5
20 to 59	370	5 to 25	19.1	3.3

rise to the 25 to 34 age group, followed by a consistent decline to the oldest group. Comparing the means of the 20 to 24 and 55 to 59-year-old subjects, a C.R. of 3.03 was found which is significant beyond the 1% level of probability. Similarly, a comparison of the difference between the mean of the 25 to 34 and that of the oldest subjects yielded a C.R. of 3.37, also significant beyond the 1% level of confidence.

A further analysis of the results is presented in Table XIX. The Pearson correlation is significant at the 0.1% level, showing a decrease in Objets defaits scores with age. But when the influence of education is nullified, the remaining relationship is significant at 1%. This change in level of significance indicates that the scores on this subtest are affected by education. Thus, the lack of education or insufficient schooling tends to produce lower scores with advancing age. On the other hand, nullifying the influence of occupation yields as high a correlation as the Pearson coefficient. Occupation would then seem to be a stabilizing influence on Objets defaits scores. Removing the influences of both education and occupation once again reduced the simple correlation to significance at the 1% level. This change in level of significance indicates that both variables influence the relationship between subtest scores and

Table XIX. - Pearson Coefficient between Age and Objets defaits Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.22[d]	.05
$r_{y1.2}$	-.16[c]	.05
$r_{y1.3}$	-.23[d]	.05
$r_{y1.23}$	-.15[c]	.05

a Symbols y, 1, 2, and 3 refer to age, subtest, education and occupation, respectively.

c Significant at 1%.

d Significant at 0.1%.

advancing age. Because the correlation is decreased when the variables are held constant, and since not all of the variance has been explained, it is suggested that other factors which are specific to the test itself are responsible for the remaining variance and that therefore, intelligence can not be said to decline with age.

In further investigating the remaining variance, Table XX shows that there are no significant relationships within the age groups. One coefficient approaching significance (5% level) is found in the 39.5 group but is reduced when the influences of education or of education and occupation are removed. Thus, the relationship between age and Objets defaits scores within the age groups cannot be thought to influence the remaining variance for the total sample.

10. Substitutions

Table XXI presents the results obtained by the sample on the Substitutions subtest. The means, with the exception of the two younger age groups, show a progressive decline through the remaining age groups. Contrasting the means of the youngest and oldest age groups, a C.R. of 6.27, significant at well beyond the 1% level, was found.

In order to explain this loss, other analyses were conducted which may be found in Table XXII. Because all

Table XX. - Pearson Coefficients between Age and Objets defaits Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.02	.10	-.04	.11	.04	.11
29.5	.05	.09	.06	.09	.06	.09
39.5	-.26[b]	.12	-.20	.12	-.20	.12
49.5	-.09	.13	-.06	.14	-.04	.14
57.5	.14	.20	.05	.21	.05	.22

b Significant at 5%.

Table XXI. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Substitutions Subtest.

Age Group	N	Range	Mean	S.D.
20 to 24	92	19 to 67	47.6	10.6
25 to 34	133	22 to 67	47.6	10.4
35 to 44	64	24 to 67	46.3	10.1
45 to 54	56	20 to 66	41.4	9.3
55 to 59	25	15 to 55	32.8	10.2
20 to 59	370	15 to 67	45.4	11.0

Table XXII. - Pearson Coefficient between Age and Substitutions Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.32[d]	.05
$r_{y1.2}$	-.26[d]	.05
$r_{y1.3}$	-.37[d]	.05
$r_{y1.23}$	-.28[d]	.05

a Symbols y, 1, 2, and 3 refer to age, subtest, education and occupation, respectively.

d Significant beyond 0.1%.

coefficients remain significant beyond the 0.1% level, one cannot speak of trends or changes in levels of significance. However, the changes in size of the correlations are very similar to those observed in other subtests. Thus, controlling the influence of education somewhat reduces the size of the Pearson coefficient; holding the effects of occupation constant increases the relationship; and nullifying the influences of both variables reduces the size of the Pearson correlation. Since these changes do occur, it is suggested that other factors which are specific to this subtest are responsible for the variance which remains especially since the two variables considered exert some influence on Substitutions scores. It is therefore concluded that intelligence, as measured by this subtest, does not decline with age.

In attempting to investigate the results more thoroughly, the age groups were studied in a similar way. These findings are included in Table XXIII. A quick glance reveals that none of the relationships within the age groups reached the required 1% level of significance. It cannot be said, therefore, that the results obtained by the sample were influenced by specific losses in test scores within any of the age groups.

Table XXIII. - Pearson Coefficients between Age and Substitutions Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.04	.10	-.13	.10	-.13	.10
29.5	.01	.09	.03	.09	.05	.09
39.5	-.20	.12	-.12	.13	-.11	.13
49.5	-.18	.13	-.12	.14	-.11	.14
57.5	-.13	.20	-.30	.19	-.31	.20

11. Echelle Verbale

Table XXIV includes the results obtained by the sample on the Echelle verbale. There is an increase in means to the 25 to 34 group, a plateau from the 25 to 44 groups, followed by a decrease to the age of 59. Comparing the 20 to 24 and the 55 to 59 age group means, a C.R. of 2.00 is obtained while one of 2.19 is found when comparing the 35 to 44 and the oldest age group, both of which are significant beyond the 5% level of confidence.

Since this is only a tendency towards a decrement it cannot be concluded that there is any decline at least up to the age of 59. It is possible that the trend continues beyond this age but with the available data, this can only remain a hypothesis.

Further analyses of results which were carried out have been incorporated in Appendix III, Table XLIII.

12. Echelle Non Verbale

The results obtained by the sample on the Echelle non verbale are presented in Table XXV. In contrasting the means of the 20 to 24 and 55 to 59 age groups, a C.R. of 4.70 was obtained. Similarly, in comparing the means of the 25 to 34 and of the oldest group, a C.R. of 4.71 was found. Both of these are significant at well beyond

Table XXIV. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Echelle verbale.

Age Group	N	Range	Mean	S.D.
20 to 24	92	19 to 80	53.3	12.7
25 to 34	133	19 to 98	54.6	14.6
35 to 44	64	27 to 79	54.6	15.1
45 to 54	56	16 to 82	52.2	15.6
55 to 59	25	19 to 82	45.0	19.2
20 to 59	370	16 to 98	53.3	14.2

Table XXV. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Echelle non verbale.

Age Group	N	Range	Mean	S.D.
20 to 24	92	59 to 159	113.3	19.7
25 to 34	133	58 to 162	114.3	20.3
35 to 44	64	71 to 148	109.9	19.2
45 to 54	56	49 to 141	102.8	18.9
55 to 59	25	52 to 141	86.5	25.8
20 to 59	370	49 to 162	109.7	21.5

the 0.1% level of confidence.

Because scores on the Echelle non verbale are the sum of five subtests, two of which have yielded results which remained significant even after the influences of education and occupation were nullified, the findings for this scale might likely be similar. This is in fact what happened as seen in Table XXVI. A significant Pearson (0.1%) was obtained when scores were correlated with age. Removing the influence of education resulted in reducing the size of the coefficient; nullifying the effects of occupation produced a higher relationship; and holding both variables constant again lowered the correlation. These trends are the same as found for the subtests above and the same conclusions would apply for the Echelle non verbale.

Pursuing the analysis further, the age groups were investigated to determine whether any one group was responsible for the sample results obtained on this scale. Table XXVII summarizes the results and shows that none of the relationships for any group were significant at 1%, generally indicating that the results for the sample were not influenced by those within the age groups. But since a correlation, significant at 5%, was obtained in the 39 to 45 group some of the decline in test scores found in the sample could possibly be attributed to this group.

Table XXVI. - Pearson Coefficient between Age and Echelle non verbale Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.31[d]	.05
$r_{y1.2}$	-.23[d]	.05
$r_{y1.3}$	-.35[d]	.05
$r_{y1.23}$	-.25[d]	.05

a Symbols y, 1, 2, and 3 refer to age, subtest, education and occupation, respectively.

d Significant at 0.1%.

Table XXVII. - Pearson Coefficients between Age and Echelle non verbale Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.02	.10	-.19	.10	-.19	.10
29.5	.01	.09	.04	.09	.05	.09
39.5	-.28[b]	.12	-.20	.12	-.20	.12
49.5	-.20	.13	-.15	.13	-.13	.14
57.5	.05	.20	-.12	.21	-.11	.22

b Significant at 5%.

13. Echelle Totale

Table XXVIII presents the results obtained by the sample on the Echelle totale. The means continue to rise to the 25 to 34 age group and to consistently decline thereafter. Comparing the means of the 20 to 24 and 55 to 59 age groups yielded a C.R. of 3.84 while one of 3.94 was found between the means of the 25 to 34 and the oldest group, both being significant beyond the 1% level of confidence.

These results were subjected to other analyses which are summarized in Table XXIX. All relationships remain highly significant even when the influences of education or of education and occupation are removed. However, the trends mentioned in connection with previously reported significant results on individual subtests and on the Echelle non verbale were also evident and the same interpretation would apply, especially since this scale is the sum of the scores of ten subtests.

Tracing the results back to the age groups, none of the correlations for the two younger and two oldest groups reached the required 1% level of confidence as seen in Table XXX. However, the 39.5 group showed a Pearson coefficient between age and the Echelle totale scores significant at 1% which was reduced to the 5% level when

Table XXVIII. - Number of Subjects, Range, Means, and Standard Deviations of Raw Scores Obtained by Each Age Group and the Total Sample on the Echelle totale.

Age Group	N	Range	Mean	S.D.
20 to 24	92	85 to 236	166.7	29.3
25 to 34	133	77 to 247	169.0	31.9
35 to 44	64	98 to 220	164.5	31.4
45 to 54	56	80 to 219	155.1	31.3
55 to 59	25	74 to 223	131.6	42.2
20 to 59	370	74 to 247	163.0	33.3

Table XXIX. - Pearson Coefficient between Age and Echelle totale Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.25[d]	.05
$r_{y1.2}$	-.15[c]	.05
$r_{y1.3}$	-.31[d]	.05
$r_{y1.23}$	-.18[d]	.05

a Symbols y, 1, 2, and 3 refer to age, subtest, education and occupation, respectively.

c Significant at 1%.

d Significant at 0.1%.

Table XXX. - Pearson Coefficients between Age and Echelle totale Scores, First and Second Order Partials Holding Education and Occupation Constant for Each Age Group, and their Respective Standard Errors.

Age Group	Pearson r	S.E.	1st Order Partial	S.E.	2nd Order Partial	S.E.
22.5	.07	.10	-.17	.10	-.17	.10
29.5	.01	.09	.05	.09	.06	.09
39.5	-.33[c]	.11	-.27[b]	.12	-.26[b]	.12
49.5	-.15	.13	-.08	.14	-.06	.14
57.5	.11	.20	-.08	.21	-.08	.22

b Significant at 5%.

c Significant at 1%.

the influences of education or of education and occupation were removed. These results, being based on the ten subtests, are a reflection of similar findings for two of the subtests.

Summing up the findings of the thirteen sections, Renseignements, Cas pratiques, Chiffres, Resemblances, Blocs a dessins, and the Echelle verbale revealed no significant differences between the means of the youngest and oldest groups or between the highest mean and that of the oldest subjects. Thus, no further analyses were required.

On the other hand, significant differences between means were found for the Arithmetique, Series d'images, Images incompletes, Objets defaits and Substitutions subtests as well as for the Echelle non verbale and Echelle totale. In the case of Arithmetique and Images incompletes all of the variance was explained by removing the influence of education indicating that insufficient education yields lower test scores as age increases. But nullifying the influence of occupation resulted in much higher negative correlations indicating that occupation compensates for what would otherwise be a greater loss in test scores with age. Controlling the effects of both variables again reduced the correlation to almost zero. These same trends were evident in the remaining three subtests and two scales mentioned above. However, only in Series d'images

and Objets defaits were there changes in levels of significance when the variables of education, or of education and occupation were controlled. Substitutions, Echelle non verbale and Echelle totale maintained highly significant relationships but the correlations were somewhat lower when education and occupation were held constant.

The age groups were also studied to determine whether there were any relationships within them which would influence the total sample results. The 39.5 group revealed significant findings on the Arithmetique and Images incompletes subtests even with the elimination of the educational and occupational influences while on the Echelle totale the significant relationship changed to one approaching significance when the influence of these two variables was controlled. A loss in scores was thus observed on the two subtests when related to the age of the group itself. In the case of Arithmetique and Images incompletes, however, the total sample did not appear to be affected by these results since most of the variance was explained by education and occupation.

From the results obtained by the total sample, it was concluded that factors which are specific to the subtests themselves were likely to be adversely affecting test scores with age since education and occupation

totally accounted for the variance in some subtests and partially explained it in others. It was also indicated that because of this, intelligence, as measured by these subtests, could not be thought to decline with age.

Exactly what the factors specific to the tests themselves are will be considered in the following section of this report which will present some generalizations concerning the nature of mental deterioration.

CHAPTER IV

THE NATURE OF DETERIORATION

The present portion of the report must consider the conclusions reached in the last chapter in the light of what past investigations have revealed. To this end, each of the six major interpretations concerning the relationship of mental deterioration to age proposed by other researchers will be discussed in conjunction with the findings of this study, followed by a general discussion on the nature of deterioration.

Wechsler[1] had concluded that intelligence declined with increasing age, claiming that it was part of the senescent process of the organism as a whole. The present author, using a different approach to explore the problem further, concluded that intelligence itself showed no decrement as age progressed in a normal population but rather that the decline which was observed on three of the performance subtests was attributable in part to the influences of education and occupation but particularly to the nature of the subtests themselves. While Wechsler held that intellectual decline was part of the senescent

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1 David Wechsler, The Measurement of Adult Intelligence, Third Edition, Baltimore, Williams and Wilkins Company, 1944, p. 15.

process, the present findings point out that this process and other elements are responsible for the decline in test scores but not of intelligence.

The statistical relationship found between age and intelligence test scores can be misleading if other factors which could also exert some influence were not taken into account. The concept that two things may be related can not necessarily be interpreted to mean that one is the cause of the other, or vice versa. Most studies claiming deterioration of mental ability have apparently confused correlation with causation in rendering their interpretations.

A basic difficulty has been that intelligence tests were equated with intelligence, the former being used as completely valid measures. If these examinations in fact measured nothing else it could then be concluded that mental ability declines with increasing age. It has been shown by this investigation that education and occupation do affect test results, as demonstrated by the more severe losses in some of the subtests when they are not held constant, and it has also been indicated that the tests themselves have an influence on these scores. If, on the other hand, it were held that not intelligence itself but its overt manifestations are being measured along with other factors, which indeed appears to be the case, then

the only sensible conclusion is to declare that it is this manifestation of basic mental ability which declines with age. There is an essential difference between this interpretation and that of actual intellectual deterioration. It would seem that with the present state of knowledge it is not possible to bridge the gap between intelligence and its direct measurement. Consequently, it is also impossible to conclude to its decline from indirect measures which also involve other factors.

Wechsler's definition of mental deterioration stressed the functioning level of the individual. Thus, the individual who could no longer "...carry on his intellectual tasks with the speed, accuracy or efficiency previously characteristic of his functioning level"[2] was considered as showing evidence of mental decline. This definition is in keeping with the present findings but the disagreement arises in the interpretation of results. On the basis of the results obtained in this investigation, the concept that intelligence declines with age must be rejected in favour of the conclusion that the measured overt manifestations of mental abilities are adversely affected by the variables of education and occupation as well as by the nature of some of the subtests themselves.

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2 Id., ibid., p. 54.

At this point, reference should be made more specifically as to how the subtests themselves can contribute to the decline in scores with age. Rapaport et al.[3], have advanced hypotheses about the three subtests in this study whose scores were found to decline with age, namely, Series d'images, Objets defaits and Substitutions. While they suggest that planning ability and anticipation[4] are being measured, other elements may be involved such as inability to perceive or discriminate between or among the fine details in the picture series because of poor eyesight, slowness in arranging the pictures because of lack of interest, or because of overcautiousness or fear of appearing incapable of performing such a simple task — any or all of which could be responsible for decline in test scores with age. Objets defaits is said to measure visual organization along with a motor element, that is, the "...visual guidance of motor action which in turn, if of proper speed, gives opportunity for reconstructing the initial visual organization"[5]. Speed and visuo-motor

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3 David Rapaport, Merton Gill and Roy Schafer, Diagnostic Psychological Testing: The Theory, Statistical Evaluation, and Diagnostic Application of a Battery of Tests., Vol. 1, Chicago, Year Book Publishers, 1946, p. 215-220, 249-259 and 288-291, passim.

4 Id., ibid., p. 215.

5 Id., ibid., p. 259.

co-ordination are thus included which may be affected by physiological and sensory breakdown as age progresses. Finally, Substitutions is reported to measure visual activity, motor activity and a learning process, and is generally regarded as a test of psychomotor speed[6]. The eye-hand co-ordination and learning elements were experimentally confirmed by Burik[7].

All three subtests can in fact be adversely affected by the increasing breakdown of the body as a whole due to the aging process since visual-motor co-ordination[8] is involved, but other elements also include "...tension, anxiety, and hyperactivity...whose impact on motor action prevents whatever visual organization would bring about"[9].

One explanation which had been put forth to refute the idea that intelligence declined with age, was based on the concept of disuse of abilities as suggested by Sorenson[10]. The notion of the specific types of materials

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6 Id., ibid., p. 288

7 Theodore E. Burik, "Relative Roles of the Learning and Motor Factors Involved in the Digit Symbol Test", in the Journal of Psychology, Vol. 30, First Half, issue of July 1950, p. 42.

8 David Rapaport, et al., op. cit., p. 249.

9 Id., ibid., p. 253.

10 H. Sorenson, "Mental Ability over a Wide Range of Adult Ages", in the Journal of Applied Psychology, Vol. 17, No. 6, issue of December 1933, p. 736.

used to assess intelligence as pointed out by Hebb and Morton[11] should also be considered along with the idea of disuse since both seem to be related. Thus, if an individual were examined on a test of vocabulary and he has continually been involved in a highly verbal type of occupation, there should be no loss in test scores, and more than likely, there should be an increase as he grows older. Similarly, if a person has been residing in a somewhat isolated area where there was little need for a large vocabulary, it is possible that while at school he may have had a larger vocabulary; but with the passage of time and little stimulation he would probably show a decrement. The concepts of use and disuse would certainly seem to apply in these situations where a specific aspect is being measured. However, in the assessment of intelligence, the test should transcend educational, occupational, cultural, environmental and geographical differences to yield a more adequate picture of the basic abilities of these individuals who may, in fact, be equally intelligent.

The argument that test scores decline because of disuse or lack of practice may be acceptable when considering the materials which constitute the examination.

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11 D.O. Hebb and N.W. Morton, "Note on the Measurement of Adult Intelligence", in the Journal of General Psychology, Vol. 30, First Half, issue of January 1944, p. 220.

This could conceivably be a partial answer to the losses in scores but is ineffective in denying the existence of the decline of intelligence since a definite link has not been established between intelligence itself and what is being measured by the test. It cannot properly be argued, therefore, that what appears to be a decline of intelligence is only an artifact because it is not being used or exercised. Rather, it could be more appropriately concluded that the decline in test scores could be prevented by practicing those tasks which are similar to the materials of tests of intelligence throughout the life span.

Examining the results obtained in the last chapter, it is possible that disuse or lack of practice may contribute to losses in test scores but on a different basis. Since it was concluded that intelligence itself does not decline with age, the concept of disuse must be applied to those tests where lack of practice could have an adverse effect on the scores. This could especially be true of Substitutions but could also apply to Objets defaits.

The role of sampling has also been mentioned as being responsible for the apparent deterioration of intelligence with age. Poor sampling[12] and the use of the

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12 Raymond J. Corsini and Katherine K. Fassett, "Intelligence and Aging", in the Journal of Genetic Psychology, Vol. 83, Second Half, issue of December 1953, p. 253.

cross-sectional[13] method of study have been cited. Reference has already been made to the controversy and difficulties involved in the developmental or longitudinal and cross-sectional approaches[14], and need not be further elaborated upon although it could be stated that both types of studies throughout a life span would likely yield much valuable information.

With reference to poor sampling, this criticism could likely be applied to a large number of investigations, but the main criticism which should be levied against studies claiming a decline in intelligence is that their statistical methods of analysis, rather than their sampling, failed to show the connection between age and intelligence. It is worthy of note that despite the different investigators, tests, samples, times and geographical areas, the results of the major investigations found essentially the same decline in scores with increasing age. However, the essential error was that this loss was readily interpreted to mean a decline of intelligence. Although this research is not beyond criticism, the same tendency toward

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13 Maurice Chagnon, Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, p. 50.

14 Anne Anastasi and John P. Foley, Differential Psychology, New York, The Macmillan Company, 1949, p. 267-268.

declining test scores was found despite the type of sample and the statistical techniques which were employed. The latter, however, have led the writer to more clearly establish a distinction between intelligence itself and its overt manifestations. Consequently, it was concluded that intelligence was not adversely affected but that some test scores were influenced by education, occupation, and by the subtests themselves in some cases, as well as by sensory and physiological changes accompanying the aging process.

The notion that mental abilities have a differential rate of decline was proposed by several authors, among whom may be mentioned Gilbert[15] and Sorenson[16]. This was an attempt to refute the argument that general intelligence declined with advancing age and is somewhat comparable to the idea of disuse of functions. However, by the very admission of this type of loss, the advocates of differential deterioration unwittingly accepted the idea of decline but somehow not quite a decrement of general intelligence. While a loss in some test scores but not in others was observed, the

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15 J.G. Gilbert, "Mental Efficiency in Senescence", in Archives of Psychology, New York, Vol. 27, No. 188, issue of July 1935, p. 268.

18 H. Sorenson, "Differential Effect of Age and Experience on Mental Abilities", in the Psychological Bulletin, Vol. 33, No. 9, issue of November 1936, p. 806.

interpretation was made that some abilities declined as age progressed while others remained relatively constant and that therefore this decrement varied in terms of the specific abilities involved. This conclusion invites criticism on three points: firstly, the same error of mistaking correlation for causation seems to have been made; secondly, no consideration was given to the specific materials of the tests themselves which could lead to the resulting differential loss in scores; finally, the differential rate of sensory and physiological changes among individuals was not taken into account.

Taking the concept of differential decline and applying it to the present findings, the only conclusion which can be reached is that the various degrees of losses among subtests may be the result of the aging process itself, which is differentially affected, and of other factors as well. The test materials themselves may produce this type of loss depending on whether the tests require visuo-motor co-ordination, visual acuity, speed of response, prolonged concentration, and so on. It should also be noted that Balinski's [17] findings have shown that the same test may be measuring different functions from one age to

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17 Benjamin Balinski, "The Analysis of the Mental Factors of Various Age Groups from 9 to 60", in Genetic Psychology Monographs, Vol. 23, First Half, issue of February 1941, p. 231.

the other which in itself could account for the increases as well as the observed differential decline of test scores.

A fifth explanation for the apparent decline of intelligence was proposed by Lorge[18] who held that there was no decline in mental abilities and that whatever losses were evident were due to the tests themselves as well as to the sensory and physiological changes which accompanied the aging process. He felt that tests which required speed were unfair to older persons since they were not given sufficient time to demonstrate their basic capacities or "power", intimating that speed was not a factor which merited consideration in the assessment of intelligence. Because the tests contained the type of material more suited to young people, that older people's vision becomes poorer, visuo-motor co-ordination less efficient, reaction time slower, and so on, he was led to discard the idea of mental deterioration. He further proposed a correction formula[19] to counterbalance the influence of aging when

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18 Irving Lorge, "The Influence of the Test Upon the Nature of Mental Decline as a Function of Age", in the Journal of Educational Psychology, Vol. 27, No. 2, issue of February 1936, p. 110.

19 Irving Lorge, "Review of the Measurement of Adult Intelligence", in the Journal of Consulting Psychology, Vol. 7, No. 3, issue of May-June 1943, p. 167.

dealing with older people, but Chagnon[20] pointed out that even with this correction, scores continued to show a decline on some of the Ottawa-Wechsler subtests. It is possible that insufficient weight was assigned to the age factor but it is more likely that other factors were operating to produce these losses as well as the fact that the aging process does not affect all individuals to the same degree at any given time of life[21].

Lorge's conclusions are in partial agreement with the results of the present investigation, although no attempt was made in this study to take the time element into consideration since it was shown[22] that the speed factor had little influence on a test such as the W.A.I.S. However, Lorge's interpretation for the observed decline in test scores failed to take into account the influences of other factors such as education and occupation as evident in this study, and still other factors which could be contributing to these decrements. Thus, both physiological and other non-intellective variables should

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20 Maurice Chagnon, op. cit., p. 39.

21 Jeanne G. Gilbert, "Measuring Mental Efficiency in Senescence", in the American Journal of Orthopsychiatry, New York, Vol. 14, No. 4, issue of April 1944, p. 268-269.

22 Jerome E. Doppelt and W.L. Wallace, "Standardization of the Wechsler Adult Intelligence Scale for Older Persons", in the Journal of Abnormal and Social Psychology, Vol. 51, No. 2, issue of September 1955, p. 329.

have been considered.

One last proposal had been advanced in part by Gilbert[23] but more comprehensively by Corsini and Fassett[24] to the effect that what appears to be a decline in intelligence is in fact a reflection of non-intellective influences. The latter authors maintained that the overt manifestations rather than intelligence itself are affected by such variables as education, occupation, experience, visual and motor losses while the former mentioned such factors as the social and physical environment. Rapaport et al.[25] added other non-intellective elements which they felt contributed to the apparent deterioration of intelligence.

Corsini and Fassett's concept is more in keeping with the conclusions of the present investigation since it takes into account the part played by the aging process itself which has a considerable influence on the decline of some test scores as a person grows older. It would appear, however, that the essential difference between these co-authors and other investigators is to be found in their interpretation since, for all practical purposes,

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23 J.G. Gilbert, op. cit., p. 268.

24 R.J. Corsini and K.K. Fassett, op. cit., p. 262.

25 D. Rapaport, et al., op. cit., p. 37-38.

their results revealed that scores on some subtests increased, some remained constant, and others declined with advancing age. Although these interpretations may not have been warranted, particularly in terms of the sample they employed, their conclusions are applicable to the findings of the present research in which the experimental design was especially selected to make possible this type of interpretation if similar results were obtained. In view of the present findings, therefore, the writer has concluded that Corsini and Fassett's deductions are directly applicable in rejecting the hypothesis that intelligence declines with increasing age.

Having individually discussed the major interpretations which were proposed to explain the losses in test scores with aging and their relationship to this investigation, the topic of the nature of deterioration may now be undertaken.

The present evidence points to the conclusion that there is no decline of intelligence with increasing age despite the decrease in test scores observed on three of the Ottawa-Wechsler subtests. Rather, it is suggested that intelligence acts as a compensating factor which partly makes up for what would otherwise be a much more severe loss in test scores as the individual grows older. This concept was expressed somewhat differently by

Litwinski[26] who felt that the individual was able to make up for actual losses through a rebirth or, failing this, through substitution and compensation. Furthermore, if the influences of education and occupation are not taken into account, these variables can also be responsible for the resulting lowering of scores. Therefore, keeping in mind the results of this study, it would be inappropriate to propose a theory of intellectual deterioration. However, some meaningful and comprehensive explanation concerning losses in test scores as influenced by the aging process and other factors may be considered. One can think in terms of a curve of the sensory and physiological breakdown of the body and its functioning and include such concepts as rigidity and loss of drive which may become progressively more pronounced as an individual grows older. These, in turn, affect the external and measurable manifestations of intelligence. In other words, the non-intellective variables inhibit the outward expression of basic intelligence, thus producing a distorted image of basic abilities.

Just how much correction would be necessary to counterbalance the negative influences of both physical and psychological elements which affect overt behaviour would

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26 Leon Litwinski, "L'Ascension et le Declin Mental en Fonction de l'Age", in Archives de Psychologie, Vol. 33, No. 129, issue of July 1950, p. 56.

be difficult to establish since one individual may be more severely handicapped than another of the same or even older age as attested to by Feifel's[27] report on the work of two neurophysiologists. This at once suggests that what would in fact be required for a completely adequate study of the entire problem of decline would be a co-ordinated approach by many disciplines comprising all kinds of sensory, physiological and psychological measurements using both the cross-sectional and longitudinal methods.

Perhaps some attention should also be given to the time element since Lorge[28] maintained that lower scores were produced on such tests as the Otis and Army Alpha because of the short time limits. In the present investigation, the time factor was not considered to be of particular significance in view of the report of Doppelt and Wallace[29]. Chagnon[30] also pointed out that some decline occurred in the non-timed verbal subtests as well

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27 Herman Feifel, "Ego Structure and Mental Deterioration", in the Journal of Personality, Vol. 20, No. 2, issue of December 1951, p. 196.

28 Irving Lorge, "Review of the Measurement of Adult Intelligence", in the Journal of Consulting Psychology, Vol. 7, No. 3, issue of May-June 1943, p. 168.

29 Jerome E. Doppelt and W.L. Wallace, op. cit., p. 329.

30 Maurice Chagnon, op. cit., p. 39.

as in the timed performance tests. However, since older people's motor activity decreases in speed, this factor should receive some consideration if one is interested in obtaining a more adequate measure of basic intelligence rather than of intellectual functioning or efficiency. Theoretically, the question may be raised as to whether it is the thinking time or reaction time which is affected. For example, does it take an older person a longer time to find the solution to a given problem because his intellectual processes are slower or does it just take him longer to actually begin to give an overt indication of having found the solution? The answer to this question would appear to be in the affirmative in both cases. It is the author's contention that intellectual processes must operate through the nervous system. If the latter has shown signs of damage or destruction due to the aging process it will be reflected in the length of time required to think a problem through and to overtly demonstrate its solution. It is quite obvious that other variables are at work such as amount of experience, personal interest and motivation, importance of the problem, painstaking care in arriving at a correct solution, and so on, which could influence speed of thought and reaction. The main point is, however, that basic intellectual activity is mediated through the nervous system and that appropriate responses

should follow when the effectors are activated. Along with this concept, two other notions should be included. Firstly, the part played by the receptors is of considerable importance since their malfunctioning can produce erroneous and unintelligent solutions based upon incomplete or misrepresented information. This can considerably increase the time required to work out a solution. The effectors can also lengthen the time necessary to overtly present it if they are not functioning properly. Secondly, even though there may be some brain cell destruction, intelligence itself is capable of surmounting this obstacle to some extent through compensatory means of expression.

Returning to the question of deterioration, the present findings lead to only one possible definition, namely, that the term must necessarily refer to the discrepancy between a previously known efficiency level and present functioning as differentially influenced by a variety of sensory, physiological, psychological and other non-intellective factors. Thus, the concept of deterioration cannot be applied to intelligence but to the demonstrable inefficiency of the total individual.

Keeping in mind the various interpretations proposed by the literature and the findings of the present investigation, it is maintained that the observed decline

in test scores is a function of the aging process with its concomitant visual, motor, auditory and other sensory and physiological decrements, whose rate and sequence of breakdown differs among individuals at any given age, interacting with the level of education, occupation and psychological influences such as lack of motivation, rigidity or interference from past learning and experience, and emotional maladjustments.

In summary, this portion of the report has considered the six major interpretations proposed to explain the losses in intelligence test scores in conjunction with the findings of the present investigation. This was followed by a consideration of the speed factor involved in the thinking process and its observable manifestations which led to a brief discussion of the relationship between the thought processes and the nervous system. The report concluded that the concept of deterioration applies only to the measurable inefficiency shown in overt behaviour and that this decline is due to sensory, physiological, psychological and other non-intellective factors.

SUMMARY AND CONCLUSIONS

This report has attempted to study differential mental deterioration with age. As was indicated, the writer undertook to investigate the problem from a different viewpoint since to the present time there was no clear evidence concerning the reality of intellectual decline.

A survey of the literature was presented in order to point out the various conclusions proposed with respect to intellectual losses which purportedly accompanied the aging process. Six major proposals were reviewed but two main divisions were evident: one accepting mental deterioration as a fact, the other only partially accepting the idea or completely rejecting it. Those favouring partial decline spoke of a differential loss of abilities with age rather than of a general decrement of intelligence. These six conclusions led to the formulation of the hypothesis of this study and were later to be employed to discuss the concept of differential mental deterioration with age.

The second chapter was concerned with the experimental design which was to be used to investigate the hypothesis. A brief description of l'Echelle d'Intelligence Ottawa-Wechsler was given and some discussion ensued concerning the variables which were to be

considered in studying the problem. The method of randomly selecting a stratified sample of the French-speaking population of greater Ottawa was outlined and the resulting sample described. A discussion of possible statistical methods of analysis was included along with the final approach which was employed.

Chapter III dealt with the presentation and analysis of data which was organized into thirteen sections to allow for a clearer presentation of results. These sections described the results obtained by the sample on each of the subtests and composite scales. When a comparison of the means of the youngest and oldest age group or between the highest mean and that of the oldest subjects resulted in statistically significant differences, further analyses were presented dealing with the total sample as well as the age groups. Those showing no significant differences were eliminated from further consideration, and analyses which had been carried out were relegated to the Appendix.

Summarizing the findings, no significant differences between the means of the youngest and oldest age groups or between the highest mean and that of the oldest subjects were found on five of the subtests, namely, Renseignements, Cas pratiques, Chiffres, Resemblances and Blocs a dessins. It was concluded that intelligence did

not decline with age, at least as measured by these subtests. However, significant differences between means were found for the Arithmetique, Series d'images, Images incompletes, Objets defaits and Substitutions subtests as well as for the Echelle non verbale and Echelle totale. Where Arithmetique and Images incompletes were concerned, all of the variance was explained by removing the influence of education, indicating that insufficient education yielded lower test scores as age progressed. Controlling the influence of occupation yielded higher negative correlations which tended to show that occupation compensated for what would otherwise have resulted in a greater decline of scores with age. But nullifying the effects of both variables again reduced the correlations to almost zero. The conclusion was that when the influences of these variables was held constant there was no justification for accepting the idea of intellectual decline as part of the aging process.

The same trends were evident on the three remaining subtests and two scales when the two variables were controlled, but only for Series d'images and Objets defaits were there changes in levels of significance when education or education and occupation were held constant. Though a numerical change or lower correlation was observed on Substitutions, Echelle non verbale and Echelle

totale, there was no change in level of significance when education and occupation were held constant. It was concluded that the nature of the subtests themselves, in addition to education and occupation, was responsible for the decline in test scores as age progressed and that therefore intelligence did not decline. The results for the Echelle non verbale and Echelle totale, being composites of the five performance and ten subtests, respectively, were similarly interpreted. A study of the results of the age groups was also included to determine what effects these would have on the total sample. However, the 39.5 group showed significant results on two subtests — Arithmetique and Images incompletes — but these were not adversely affected in the total sample when the influences of education and occupation were controlled.

The last portion of the report took into account the six major proposals garnered from the literature and attempted to integrate these with the findings of the present study. It was pointed out that erroneous interpretations were given to the results of studies which accepted mental deterioration as an evident fact since some authors tended to equate intelligence with intelligence tests. Those who spoke of a differential decline were guilty of the same error, though to a lesser

extent. It was suggested that in the case of the three subtests — Series d'images, Objets defaits and Substitutions — showing losses in scores with age even when the influences of education and occupation were held constant, these decrements were due to the nature of the subtests themselves which measure visual acuity, motor activity and the co-ordination of both as well as to other elements. Visuo-motor activity was thus related to the sensory and physiological breakdown which accompanies aging.

The present investigation concluded that no evidence was found to accept the idea that intelligence declines with age. It was indicated that the decline observed on three subtests was due to non-intellective factors and that intelligence acts as a compensatory mechanism which helps to prevent a more severe loss in test scores. As a result, it was thought inappropriate to propose a theory of intellectual decline. Rather, it was submitted that a curve of the sensory and physiological changes which accompany aging along with the measurement of psychological elements such as rigidity, experience and lack of drive which affect the external and measurable manifestations of intelligence, be investigated. In order to do this, a co-ordinated approach by many disciplines is advocated which would involve numerous physical,

physiological and psychological measurements, using both cross-sectional and longitudinal methods throughout a life span. This suggestion for further research was followed by some discussion of the time element involved in the intellectual process which is mediated through the nervous system. The report concluded by stating that the concept of deterioration may be applied only to the measurable inefficiency shown in overt behaviour which is due to sensory, physiological, psychological and other non-intellective factors.

BIBLIOGRAPHY

Chagnon, Maurice, Manuel et Normes de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1953, 40 p.

A manual for the administration and scoring of the Ottawa-Wechsler. It describes the subtests, population, standardization of the test, and points out that the weighted scores were based on the total sample.

--------- Utilisation de l'Echelle d'Intelligence Ottawa-Wechsler, Ottawa, Les Editions de l'Universite d'Ottawa, 1955, 56 p.

This booklet deals with the interpretation and application of the Ottawa-Wechsler. The second chapter is devoted to discussion of the relationship between intelligence and age and concludes that mental deterioration is not yet an evident fact.

Corsini, Raymond J., and Katherine K. Fassett, "Intelligence and Aging", in the Journal of Genetic Psychology, Vol. 83, Second Half, issue of December 1953, p. 249-264.

From their investigation of a prison population, the authors concluded that intelligence itself did not decline in later maturity and that losses in test scores were due to the aging process and other non-intellective factors.

Doppelt, Jerome E., and W.L. Wallace, "Standardization of the Wechsler Adult Intelligence Scale for Older Persons", in the Journal of Abnormal and Social Psychology, Vol. 51, No. 2, issue of September 1955, p. 312-330.

Two relevant notions are contained in this report: one, that differences between the sexes were small enough to permit their combination; the other, that with this type of test, the speed element did not contribute to significant differences in performance.

Jones, Harold E., and H.S. Conrad, "The Growth and Decline of Intelligence: A Study of a Homogeneous Group between the Ages of Ten and Sixty", in Genetic Psychology Monographs, Vol. 13, No. 3, issue of March 1933, p. 229-297.

One of the large scale investigations which revealed a decline in test scores to the fourteen-year-old level. The authors concluded to the decline of intelligence as individuals grew older.

Litwinski, Leon, "L'Ascension et le Declin Mental en Fonction de l'Age" in Archives de Psychologie, Vol. 33, No. 129, issue of July 1950, p. 49-70.

This report reveals that the problem of mental deterioration remains complex and unresolved. Concepts such as compensation, substitution, renewal of vital forces, are proposed to refute the idea of the decline of intelligence with age.

Lorge, Irving, "The Influence of the Test Upon the Nature of Mental Decline as a Function of Age", in the Journal of Educational Psychology, Vol. 27, No. 2, issue of February 1936, p. 100-110.

Although results similar to other investigations were observed, the writer concluded that intelligence did not deteriorate in later maturity. Emphasis was placed on the speed-power concept and it was his contention that decline in test scores was due to sensory and physiological changes produced by the aging process.

-------- "Review of the Measurement of Adult Intelligence", in the Journal of Consulting Psychology, Vol. 7, No. 3, issue of May-June 1943, p. 167-168.

A criticism of the Wechsler-Bellevue test and of Wechsler's conclusion that intelligence declined with age.

-------- "Intellectual Changes During Maturity and Old Age", in the Review of Educational Research, Vol. 14, No. 5, issue of December 1944, p. 438-445.

A review of past studies led the author to admit that changes in performance occur as people grow older but that these were produced by influences other than the decline of intelligence itself, namely sensory and physiological factors.

Miles, Catherine Cox, and Walter M. Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity", in the American Journal of Psychology, Vol. 44, No. 1, issue of January 1932, p. 44-78.

A major study revealing that the curve of intelligence persists in its downward course after reaching its maximum at the age of eighteen, which by the age of eighty-five was 62% of the original high score.

Nyssen, R. and L. Delys, "Contribution a l'Etude du Probleme du Declin Intellectuel en Fonction de l'Age", in Archives de Psychologie, Vol. 33, No. 132, issue of November 1952, p. 295-310.

While holding educational, occupational, social and community influences constant, a decline in test scores was still observed on the Progressive Matrices at all levels of intelligence whether they limited it to twenty minutes or allowed for an indefinite period of time. They concluded that these decrements were due to the progressive deterioration of intellectual ability with advancing age.

Owens, W.A., "Age and Mental Abilities: A Longitudinal Study", in Genetic Psychology Monographs, Vol. 48, First Half, issue of August 1953, p. 3-54.

A test-retest study with a thirty year interval revealed that no losses in test scores were found but that significant increases on some of the subtests resulted. Therefore no decline of intelligence with age resulted.

Rapaport, David, Merton Gill and Roy Schafer, "The Bellevue Scale", in Diagnostic Psychological Testing: The Theory, Statistical Evaluation, and Diagnostic Application of a Battery of Tests., Vol. 1, Chicago, Year Book Publishers, 1946, p. 44-318.

The authors present a number of hypotheses concerning the nature of the Wechsler-Bellevue subtests. Pages 215 to 291, passim, were particularly relevant to the discussion of mental deterioration in terms of the specific functions being measured by the subtests whose scores decline with age.

Sloan, William, "Validity of Wechsler's Deterioration Quotient in High Grade Mental Defectives", in the Journal of Clinical Psychology, Vol. 21, No. 6, issue of September 1930, p. 451-459.
An investigation with high grade mental defectives demonstrated that the concept of deterioration cannot be validly applied to this type of individual, suggesting that a study of mental decline should eliminate this type of subject.

Sorenson, H., "Mental Ability over a Wide Range of Adult Ages", in the Journal of Applied Psychology, Vol. 17, No. 6, issue of December 1933, p. 729-741.
The concept of disuse was proposed to explain the losses in test scores and to refute the notion that intelligence deteriorates with age. The idea for a different method of classifying occupations is indirectly suggested by the report.

-------- "Differential Effects of Age and Experience on Mental Abilities", in the Psychological Bulletin, Vol. 33, No. 9, issue of November 1936, p. 805-806.
A study revealing that some abilities remain constant, others increase and still others decline. Adult opportunity and experience contribute to the differential effects upon test results.

Stewart, Naomi, "AGCT Scores of Army Personnel Grouped by Occupations", in Occupations, Vol. 26, No. 1, issue of October 1947, p. 5-41.
A relationship between AGCT results and occupation was found but persons obtaining high scores were also to be found in the lower levels of occupation.

Sward, Keith, "Age and Mental Ability in Superior Men", in the American Journal of Psychology, Vol. 58, No. 4, issue of October 1945, p. 443-479.
A study using highly intelligent and active individuals revealed that lack of practice as well as the particular tests used were responsible for declining test scores in later maturity. The conclusion was that in the upper ranges of ability, impairment of higher mental processes for the years beyond sixty was by no means a foregone conclusion.

Vernon, P.E., "Changes in Abilities from 14 to 20 Years", in Advancement of Science, Vol. 5, No. 18, issue of July 1948, p. 138.
This report particularly emphasized that even at the younger age levels a decline in test scores may be obtained in lower grade occupations, while increases are recorded for those in the more "intellectual" occupations and those receiving the stimulation of further education. Disuse was cited as being responsible for declining scores.

Vincent, D.F., "The Linear Relationship Between Age and Score of Adults in Intelligence Tests", in Occupational Psychology, Vol. 26, No. 4, issue of October 1952, p. 243-249.
A linear decline was obtained between age and intelligence test scores in a sample aged 20 to 60. A mean annual decline of .030 σ was found for the Wechsler-Bellevue.

Wechsler, David, The Measurement of Adult Intelligence, Third Edition, Baltimore, Williams and Wilkins Company, 1944, vii-258 p.
A fundamental and related work upon which the Ottawa-Wechsler was based. Chapter 6, pages 54 to 69, was devoted to an explanation of the decline in test scores, leading to the conclusion that intelligence declined with increasing age.

Yerkes, Robert M., "Psychological Examining in the United States Army", in Memoirs of the National Academy of Sciences, Vol. 15, Washington, Government Printing Office, 1921, vi-890 p.
The first large scale investigation of the influence of age upon intelligence revealed losses in test scores in older age groups. Arguments were presented to reject the idea that intelligence itself deteriorated with age.

APPENDIX 1

LIST OF CODE NUMBERS CORRESPONDING TO THE ORIGINAL SOURCE OF DATA

Appendix 1 lists the code numbers of each subject corresponding to the original record forms from which the data for this investigation was obtained. These same numbers may be found in the upper left hand corners of each record form written and circled in green ink. All pertinent information from a pool of 980 records was transcribed from which 370 were chosen to represent the French-speaking population of greater Ottawa. Because of the bulkiness of and difficulties met in tabulating the raw data and since the original records are readily available, the raw scores have not been included.

List of Code Numbers Corresponding to the Original Source of Data.

3	86	157	274	374	502	582	675	790	877
5	87	158	275	407	503	583	678	792	878
7	90	159	276	412	504	584	679	796	886
17	91	160	277	413	508	585	680	798	892
20	95	161	282	414	509	586	682	799	893
25	98	162	286	416	511	587	683	801	894
27	99	163	289	417	512	588	689	802	895
30	100	180	290	420	514	591	695	803	897
32	101	181	291	422	519	592	697	804	899
33	102	182	294	424	521	593	701	809	900
34	103	183	295	426	524	595	702	812	908
36	104	184	297	429	525	597	703	813	911
37	105	185	300	430	526	598	706	814	918
40	106	187	301	434	527	599	708	815	920
41	107	188	304	436	529	600	711	817	923
42	109	189	307	440	532	601	713	818	925
46	110	195	309	443	538	606	717	823	926
47	115	196	314	446	544	608	724	832	927
51	116	197	317	447	545	610	727	833	933
54	118	199	318	448	546	614	732	836	938
55	119	204	352	449	552	615	738	838	939
56	121	207	354	450	554	616	741	839	940
58	123	240	355	452	557	617	742	840	944
60	128	241	356	469	560	621	743	844	946
65	129	242	357	471	563	625	744	846	947
67	130	244	358	472	565	626	746	848	948
68	134	246	359	473	567	658	748	849	950
70	135	247	360	474	570	663	766	853	951
71	136	248	361	475	571	664	768	855	959
73	140	249	365	476	572	665	769	857	960
74	143	250	366	477	575	666	772	859	961
77	145	251	367	479	576	667	775	862	962
78	148	252	368	481	577	668	779	865	964
80	149	253	369	482	578	669	781	870	974
81	151	269	370	484	579	670	785	872	976
84	155	270	372	495	580	671	787	874	978
85	156	273	373	499	581	672	788	875	979

APPENDIX 2

TABLES OF PEARSON CORRELATIONS

Tables of Pearson correlations which were used in the computation of partial coefficients are presented. The first Table presents intercorrelations among the variables of age, education and occupation for each age group and the total sample. The remaining Tables incorporate the correlations computed between the subtests and composite scales and the variables of age, education and occupation, for each age group and for the total sample.

Table XXXI. - Pearson Correlations and Corresponding Standard Errors Among the Variables of Age, Education and Occupation for Each Age Group and the Total Sample.

Age Group	Education	S.E.	Occupation	S.E.
20 to 24				
Age	.26[b]	.10	.13	.10
Education			.50[c]	.08
25 to 34				
Age	-.05	.09	-.08	.09
Education			.71[c]	.04
35 to 44				
Age	-.20	.12	-.16	.12
Education			.60[c]	.08
45 to 54				
Age	-.15	.13	-.15	.13
Education			.66[c]	.08
55 to 59				
Age	.20	.20	.14	.20
Education			.78[c]	.08
20 to 59				
Age	-.21[c]	.05	.05	.05
Education			.61[c]	.03

b Significant at 5%.

c Significant at or beyond 1%.

Table XXXII. - Pearson Correlations and their Respective Standard Errors between Age, Education and Occupation and Each of the Subtests and Composite Scales for the Age Group 20 to 24.

Subtest	Age	S.E.	Educ.	S.E.	Occup.	S.E.
Renseignements	.23[b]	.10	.73[c]	.05	.42	.09
Cas pratiques	.08	.10	.39[c]	.09	.18	.10
Chiffres	-.09	.10	.13	.10	.17	.10
Arithmetique	.02	.10	.55[c]	.07	.31[c]	.10
Resemblances	.11	.10	.54[c]	.07	.35[c]	.09
Series d'images	.10	.10	.44[c]	.08	.11	.10
Images incompletes	.18	.10	.42[c]	.09	.27[c]	.10
Blocs a dessins	-.02	.10	.46[c]	.08	.16	.10
Objets defaits	.02	.10	.22[c]	.10	-.03	.10
Substitutions	.04	.10	.56[c]	.07	.46[c]	.08
Ech. verbale	.14	.10	.69[c]	.06	.41[c]	.09
Ech. non verbale	.02	.10	.63[c]	.06	.35[c]	.09
Ech. totale	.07	.10	.72[c]	.05	.42[c]	.09

b Significant at 5%.

c Significant at 1%.

Table XXXIII. - Pearson Correlations and their Respective Standard Errors between Age, Education and Occupation and Each of the Subtests and Composite Scales for the Age Group 25 to 34.

Subtest	Age	S.E.	Educ.[c]	S.E.	Occup.	S.E.
Renseignements	-.01	.09	.68	.05	.49[c]	.07
Cas pratiques	.09	.09	.49	.07	.35[c]	.08
Chiffres	-.06	.09	.33	.08	.38[c]	.07
Arithmetique	-.02	.09	.53	.06	.43[c]	.07
Resemblances	-.08	.09	.63	.05	.55[c]	.06
Series d'images	-.04	.09	.29	.08	.29[c]	.08
Images incompletes	.06	.09	.45	.07	.32[c]	.08
Blocs a dessins	-.07	.09	.47	.07	.35[c]	.08
Objets defaits	.05	.09	.23	.08	.18[b]	.08
Substitutions	.01	.09	.48	.07	.42[c]	.07
Ech. verbale	.00	.09	.72	.04	.58[c]	.06
Ech. non verbale	.01	.09	.54	.06	.44[c]	.07
Ech. totale	.01	.09	.67	.05	.54[c]	.06

b Significant at 5%.

c Significant at or beyond 1%.

Table XXXIV. - Pearson Correlations and their Respective Standard Errors between Age, Education and Occupation and Each of the Subtests and Composite Scales for the Age Group 35 to 44.

Subtest	Age	S.E.	Educ.[c]	S.E.	Occup.	S.E.
Renseignements	-.35[c]	.11	.76	.05	.54[c]	.09
Cas pratiques	-.13	.12	.37	.11	.30[c]	.11
Chiffres	-.09	.13	.47	.10	.30[c]	.11
Arithmetique	-.38[c]	.11	.58	.08	.40[c]	.11
Resemblances	-.33[c]	.11	.72	.06	.64[c]	.07
Series d'images	-.29[b]	.12	.40	.11	.22	.12
Images incompletes	-.42[c]	.10	.51	.09	.26[b]	.12
Blocs a dessins	-.09	.12	.38	.11	.35[c]	.11
Objets defaits	-.26[b]	.12	.42	.10	.24[b]	.12
Substitutions	-.20	.12	.47	.10	.35[c]	.11
Ech. verbale	-.33[c]	.11	.74	.06	.56[c]	.09
Ech. non verbale	-.28[b]	.12	.58	.08	.42[c]	.10
Ech. totale	-.33[c]	.11	.71	.06	.53[c]	.09

b Significant at 5%.

c Significant at or beyond 1%.

Table XXXV. - Pearson Correlations and their Respective Standard Errors between Age, Education and Occupation and Each of the Subtests and Composite Scales for the Age Group 45 to 54.

Subtest	Age	S.E.	Educ.	S.E.	Occup.[c]	S.E.
Renseignements	-.09	.13	.62[c]	.08	.67	.07
Cas pratiques	.00	.13	.23	.13	.42	.11
Chiffres	-.17	.13	.32[c]	.12	.33	.12
Arithmetique	-.07	.13	.42[c]	.11	.61	.08
Resemblances	-.05	.13	.42[c]	.11	.59	.09
Series d'images	-.03	.13	.34[c]	.12	.41	.11
Images incompletes	-.24	.13	.29[b]	.12	.48	.10
Blocs a dessins	-.18	.13	.40[c]	.11	.36	.12
Objets defaits	-.09	.13	.23	.13	.33	.12
Substitutions	-.18	.13	.53[c]	.10	.42	.11
Ech. verbale	-.07	.13	.55[c]	.09	.68	.07
Ech. non verbale	-.20	.13	.53[c]	.10	.52	.10
Ech. totale	-.15	.13	.59[c]	.09	.65	.08

b Significant at 5%.

c Significant at or beyond 1%.

Table XXXVI. - Pearson Correlations and their Respective Standard Errors between Age, Education and Occupation and Each of the Subtests and Composite Scales for the Age Group 55 to 59.

Subtest	Age	S.E.	Educ.[c]	S.E.	Occup.	S.E.
Renseignements	.19	.20	.91	.04	.70[c]	.11
Cas pratiques	.33	.18	.54	.14	.40[b]	.17
Chiffres	-.01	.20	.78	.08	.66[c]	.11
Arithmetique	-.03	.20	.73	.10	.60[c]	.13
Resemblances	.20	.20	.70	.10	.61[c]	.13
Series d'images	.14	.20	.65	.12	.58[c]	.14
Images incompletes	.22	.19	.72	.10	.48[c]	.16
Blocs a dessins	.08	.20	.49	.15	.44[c]	.16
Objets defaits	.14	.20	.47	.16	.32	.18
Substitutions	-.13	.20	.57	.14	.58[c]	.14
Ech. verbale	.17	.20	.85	.06	.68[c]	.11
Ech. non verbale	.05	.20	.68	.11	.59[c]	.13
Ech. totale	.11	.20	.80	.07	.67[c]	.11

b Significant at 5%.

c Significant at or beyond 1%.

Table XXXVII. - Pearson Correlations and their Respective Standard Errors between Age, Education and Occupation and Each of the Subtests and Composite Scales for the Total Sample.

Subtest	Age	S.E.	Educ.[c]	S.E.	Occup.[c]	S.E.
Renseignements	-.05	.05	.70	.03	.53	.04
Cas pratiques	-.06	.05	.39	.05	.32	.05
Chiffres	-.11[b]	.05	.39	.04	.33	.05
Arithmetique	-.12[b]	.05	.56	.04	.43	.04
Resemblances	-.16[c]	.05	.60	.03	.52	.04
Series d'images	-.20[c]	.05	.41	.04	.26	.05
Images incompletes	-.09	.05	.46	.04	.33	.05
Blocs a dessins	-.20[c]	.05	.46	.04	.30	.05
Objets defaits	-.22[c]	.05	.34	.05	.16	.05
Substitutions	-.32[c]	.05	.54	.04	.37	.04
Ech. verbale	-.12[b]	.05	.74	.02	.59	.03
Ech. non verbale	-.31[c]	.05	.60	.03	.40	.04
Ech. totale	-.25[c]	.05	.70	.03	.51	.04

b Significant at 5%.

c Significant at or beyond 1%.

APPENDIX 3

PEARSON AND PARTIAL CORRELATIONS FOR THOSE SUBTESTS NOT ANALYSED IN CHAPTER III

Tables similar to those found in Chapter III, which present Pearson and partial correlations, have been included to allow for some measure of continuity and to permit the reader to observe the further analysis of results for those subtests which yielded no significant differences between the highest mean and that of the oldest subjects. Tables have been included for the Renseignements, Cas pratiques, Chiffres, Resemblances and Blocs a dessins subtests as well as for the Echelle verbale.

Table XXXVIII. - Pearson Coefficient between Age and Renseignements Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.05	.05
$r_{y1.2}$	.14[c]	.05
$r_{y1.3}$	-.08	.05
$r_{y1.23}$	.11[b]	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

c Significant at 1%.

Table XXXIX. - Pearson Coefficient between Age and Cas pratiques Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.06	.05
$r_{y1.2}$	.02	.05
$r_{y1.3}$	-.26[d]	.05
$r_{y1.23}$	.00	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

d Significant beyond 0.1%.

Table XL. - Pearson Coefficient between Age and Chiffres Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.11[b]	.05
$r_{y1.2}$	-.03	.05
$r_{y1.3}$	-.13[c]	.05
$r_{y1.23}$	-.06	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

c Significant at 1%.

Table XLI. - Pearson Coefficient between Age and Resemblances Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.16[c]	.05
$r_{y1.2}$	-.04	.05
$r_{y1.3}$	-.22[d]	.05
$r_{y1.23}$	-.10	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

c Significant at 1%.

d Significant beyond 0.1%.

Table XLII. - Pearson Coefficient between Age and Blocs a dessins Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.20[d]	.05
$r_{y1.2}$	-.12[b]	.05
$r_{y1.3}$	-.70[d]	.03
$r_{y1.23}$	-.13[b]	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

d Significant at 0.1%.

Table XLIII. - Pearson Coefficient between Age and Echelle verbale Scores and Partials Nullifying the Influences of Education and Occupation Individually and in Combination, and their Corresponding Standard Errors for the Total Sample.

Statistic[a]	Correlation	S.E.
r_{y1}	-.12[b]	.05
$r_{y1.2}$	.05	.05
$r_{y1.3}$	-.18[c]	.05
$r_{y1.23}$	.00	.05

a Symbols y, 1, 2 and 3 refer to age, subtest, education and occupation, respectively.

b Significant at 5%.

c Significant at 1%.

APPENDIX 4

ABSTRACT OF

Mental Deterioration and the Ottawa-Wechsler[1]

The aim of the study was to determine the reality of the concept of differential mental deterioration with age through the use of l'Echelle d'Intelligence Ottawa-Wechsler. A revue of the literature revealed six major conclusions which fell into two main categories: those which accepted the notion of intelligence declining with age and those which rejected it. Among the latter, some authors spoke of a differential decline of abilities while others ascribed losses in scores to disuse of functions, sensory and physiological changes, educational, occupational and intellectual levels, and to other non-intellective factors. As a result of this survey, it was hypothesized that test scores did not decline with age either generally or differentially when the influences of education, occupation and Intelligence Quotient were held constant. Unfortunately, Intelligence Quotient could not meaningfully be included because of its relationship to the test itself and was therefore eliminated from further consideration.

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1 Doctoral Dissertation presented by Pascal J. Delli Colli, in 1964, to the School of Psychology and Education of the University of Ottawa, 156 pages.

A randomly selected stratified sample of the working French-speaking population of greater Ottawa, consisting of 370 subjects, was chosen from a pool of 980 Ottawa-Wechsler records. Comparisons between the means of the youngest and oldest age groups or between the highest mean and that of the oldest subjects were made for each of the subtests and composite scales. Where differences reached the 1% level of statistical significance, the method of partial correlation was applied to the sample, followed by a similar analysis of the age groups to determine what effects, if any, they had on the sample.

No significant differences between the means of the youngest and oldest age groups or between the highest mean and that of the oldest subjects were found on Renseignements, Cas pratiques, Chiffres, Resemblances, Blocs a dessins and the Echelle verbale. Differences were obtained for the remaining five subtests and two Scales.

In dealing with the Arithmetique and Images incompletes subtests, further analysis revealed that when the influences of education and occupation were nullified, all or most of the variance was explained by these variables since the Pearson correlations were reduced to zero or nearly so. Only in three subtests — Series d'images, Objets defaits and Substitutions — was there still a significant decline in scores after the educational

and occupational influences were held constant. The same was true of the Echelle non verbale and the Echelle totale. However, Series d'images and Objets defaits yielded lower correlations and changes in levels of significance when the two variables were controlled, while the remaining subtest and two Scales produced only a slight lowering of the coefficients. It was concluded that losses in test scores on the three subtests was due to the nature of the subtests themselves in addition to the effects of education and occupation. These subtests are said to measure visual acuity, motor activity and the co-ordination of both, all of which are related to sensory and physiological changes accompanying the aging process. It could not be said, therefore, that intelligence itself declines either generally or differentially as age progresses, but rather that it compensates for what would otherwise be a more severe loss in test scores due to changes in sensory and physiological functions, interacting with psychological and other non-intellective influences which are peculiar to the individual as he grows older.