JYVÄSKYLÄ STUDIES IN EDUCATION, PSYCHOLOGY AND SOCIAL RESEARCH 31

RISTO KÄÄRIÄINEN

PHYSICAL, INTELLECTUAL, AND PERSONAL CHARACTERISTICS OF DOWN'S SYNDROME

UNIVERSITY OF JYVÄSKYLÄ, JYVÄSKYLÄ 1975

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Pieksämäki 1975 Sisälähetysseuran Raamattutalon offsetpaino

PREFACE

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Pieksämäki, May 5, 1975

Risto Kääriäinen

CONTENTS

1. INTRODUCTION

1.1. Research relating to cognitive, affective, conative, and adaptive behavior in mental retardation

In psychology the cognitive aspects of the mind are better known than the affective, conative or adaptive. The cognitive aspects of the mind have also traditionally been the most important argument in the definition of mental retardation.

The above mentioned aspects of the mind can be sub- or abnormal, and the normal development of the mind can be complicated by a delayed normal development.

Subnormal cognitive development can produce abnormal adaptive, affective or conative behaviors, but they can occur even without subnormal cognitive development. Subnormal cognitive development can also lack the main symptoms of adaptive, affective or conative behavioral disturbances, but can never be fully adaptive, when compared with normal behavior, if cognitive defects are present during and after the developmental period.

The primary position of cognitive development in relation to the other aspects of the mind is obvious. It is, however, important to emphasize the need to relate the cognitive to the affective, conative, and adaptive aspects of the mind. This has been done in the branch of psychology dealing with normal development and such research has been expanded also to the problems of the subnormal mind.

The operationalistic properties of the cognitive aspects of the mind have longer research traditions than the adaptive, affective or conative aspects, but only all these together enable us to understand more clearly the complexities lying behind the subnormal behavior.

Expanding diagnostic knowledge and expecially the expanding use of computers have increased research which attempts to explore with observable and measureable behavior the feasibility of discriminating among the subtypes of mental retardation and at the same time to clarify the diagnostic features of the subtypes of mental retardation.

1.2. Down's syndrome and the objectives of the present study

The best known and also most intensively studied subtype of mental retardation is Down's syndrome (DS).

Over a hundred years have passed since in 1866 Langdon Down first described a condition among mentally retarded which he named mongolian idiocy. Early authorities all agreed in crediting him with the discovery of a clinical entity (Penrose & Smith 1966). The description of the syndrome, which now bears the name of the finder, appeared in the London Hospital Reports entitled "Observations on Ethnic Classification of Idiots (Langdon Down 1866).

Since the turn of the century a long series of surveys, each of them emphasizing a different aspect of the condition, has been published. They are described in detail in many books written about Down's syndrome (Benda 1946, 1960, 1969, Brousseau & Brainerd 1928, Crookshank 1924, Engler 1949, Gustavson 1964, Hall 1964, Joseph & Dawbarn 1970, Øster 1953, Penrose 1961, Penrose & Smith 1966).

The most extensive one is the book by Penrose & Smith (1966).

Early and later ideas on the causation of Down's syndrome varied greatly until 1959, when Lejeune, Gautier, & Turpin published their paper showing that Down's syndrome cases have an extra acrocentric chromosome and a total diploid chromosomal number of 47. The causation of this extra chromosome no 21 is still not clear. Down's syndrome has been the first known chromosomal abnormality of the human being. The first translocation case of Down's syndrome was reported a year later by Polani et al. (1960) and the first mosaic cases of Down's syndrome in 1961 by Clarke, Edwards, & Smallpeice.

Many alternative terms have been suggested for this condition. Since Down introduced the Mongolian type of idiocy, many variations have arisen like mongol, mongolism, mongoloid, or acromicria, fetal dysplasia, and peristatic amentia. According to the classification of the karyotype, the name trisomy 21 anomaly has also been used. Down's disease has been used for a long time in the USSR. The term Down's syndrome has only recently been considered in other countries. It has, however, been used in the present study.

The diagnosis of Down's syndrome was based only on the characteristic physical signs or stigmata before the karyotype analysis was found. Characteristics physical signs are found in lips, oral cavity, tongue, teeth, voice, nose, eyes, ears, neck, heart, abdomen, skin, hair, secondary sex characteristics, and endocrine glands.

Special features are also found in osseus development, cranium, vertebral columns, pelvis, hips, hand, feet, stature, and muscular system.

Typical features are also found in the dermal ridge patterns of hands and feet.

There are changes accompanied by physical signs (Øster 1953) and also in behavior (Francis 1970) with increasing age of Down's syndrome. The neurologic aspects of Down's syndrome are non-specific. No specific biochemical defect is characteristic of Down's syndrome, either (Paulson et al. 1969).

The diagnosis of the syndrome for children and adults is usually based on the ten most characteristic signs selected by Øster (1953). They differ somewhat from those for the newly-born given by Hall (1964).

Cytological and clinical investigations have to be carried out simultaneously to reach as exact an assessment as possible (Penrose & Smith, p. 100).

The incidence of the 13-15:21 translocation among all cases of Down's syndrome is between 2 and 3 per cent (Turpin & Lejeune 1965) and of the 21-22:21 translocation about 1 per cent (Penrose & Smith 1966, Turpin & Lejeune 1965).

Together the mosaic and translocation cases of Down's syndrome constitute approximately 5 per cent and the regular trisomic 21 cases 95 per cent of all Down's syndrome cases (Dey 1971, Hongell et al. 1972, Mental Retardation, 1965, p. 24).

No investigation has identified consistent biological or psychological differences among mosaicism, translocation, and regular trisomy Down's syndrome, with the possible exception of IQ level for the latter two groups. No firm conclusion is warranted either for or against a behavioral specifity of aberrant cytogenetic subclass within Down's syndrome. It seems more likely that any departure from the regular trisomy-21 karyotype might contribute to increased somatic and behavioral variability for the syndrome, but little else. The only significant trend appears to be a greater phenotypic heterogeneity, which is associated with karyotypic heterogeneity (Gibson 1973).

A universal characteristic in Down's syndrome is the diminution of the intellectual powers and the most frequent type is the moderate level of intelligence (McIntire et al. 1965, Dey 1971).

Writing, drawing and simple industrial tasks are within their scope, but not higher intellectual operations.

The personality and temperament are usually considered to be distinctive, but there are investigators who have denied that there is any well-defined stereotype behavior in Down's syndrome.

Differences in clinical signs and in physical growth have been studied earlier in a more detailed way in univariate analyses, but the behavioral characteristics of Down's syndrome have not been studied to the same extent and also mostly only in univariate analyses.

When considering the regular type of Down's syndrome as a group, it seems reasonable to expect that a chromosomal defect empirically capable of producing gross physical effects is likely to cause distinctive pattern differences across objectively measured behaviors.

The principal objective of the present study is to attempt, with the help of multivariate statistical analyses, to reveal possible pattern differences in measured physical growth, in measured intelligence, in rated personality traits and in rated social comptence between Down's syndrome and non-Down's syndrome groups of severely and moderately mentally retarded subjects in open and residential care.

1.3. Physical growth

1.3.1. Physical growth research in mental retardation

The study of Tarbell (1883) is the first anthropometric evaluation of mentally retarded individuals. Several other studies have later confirmed that there is a positive correlation between mental defect and growth failure. These studies have been reviewed by Goddard (1912), Doll (1916), Davenport & Minoque (1930), Paterson (1930), Abernethy (1936), and Flory (1936). More recent investigations on the same topic have been published by Jones (1958), Dutton (1959), Van Gelderen (1962), Rundle & Sylvester (1963), Culley et al. (1963), and Mosier et al. (1965).

The most frequent observation is that physical growth in mental retardation proceeds at a slower rate than in normals and continues for a longer period of time. Puberty is delayed in mentally retarded individuals as compared with normals. On the other hand a slight correlation has been found between physical growth and intellect in normal individuals (Tanner 1966).

The studies of Dutton (1959) and Van Gelderen (1962) reported that certain diagnostic groups of mentally retarded individuals have normal or near-normal linear growth. In the study of Dutton these groups were the organic and non-pathological undifferentiated categories and in the study of Van Gelderen the perinatal injury, postnatal injury, and mild oligophrenia categories.

In Mosier et al's study (1965) of the ten physical measures, the body weight, crown-heel height, symphysis-heel height, biacromial diameter, and bicristal diameter had smaller dimensions than normal in both sexes and the degree of impairment was related to the degree of IQ deficit. The effect of lesions on the growth hormone mechanism is still unknown, but various known physiological mechanisms may be involved especially after certain hypothalamic and amygdaloid lesions. The authors concluded that the way in which brain injury produces stunted growth in the human is unclear and further work will be needed on genetic, nutritional, neurophysiological, and endocrine aspects of physical growth before this mechanism can be defined.

Most of the growth studies with mentally retarded individuals have been cross-sectional. Longitudinal growth studies together with various physiological parameters should provide more meaningful data. Our knowledge of growth regulating mechanisms in the brain is, however, incomplete until more is known of the role of the central nervous system in growth regulation (Mosier et al. 1965).

1.3.2. Physical growth research in Down's syndrome

Anthropometric measurements of Down's syndrome are fewer than studies with the physical signs and stigmata of the syndrome and are usually based on univariate analyses.

The over-all effect is for the Down's syndrome to be shorter than normal (Talbot 1924, Benda 1946). The average adult height of male cases of Down's syndrome is approximately 151 cm and of female approximately 141 cm. In the group of DS adults measured by Øster (1953) the height varied from 135 to 170 in males and 127 to 158 cm in females.

According to Talbot the reduced stature in Down's syndrome is mainly influenced by the reduced length of their lower extremities. The length of the trunk closely approximates to the normal at least up till the age of ten years. The trunk length in adults is probably only slightly reduced as compared with the marked reduction in length of the lower extremities. The upper extremities are similarly reduced in length. There is a deficient growth at the distal ends of the long bones (Benda 1960, Engler 1949).

Dutton (1959) reported that in a group of Down's syndrome boys aged 6-18 years none was within two standard deviations of normal boys of a similar age. He contrasted the markedly reduced height of Down's syndrome with their essentially normal skeletal development. Dutton showed

that skeletal maturation is normal in 80 per cent of cases of Down's syndrome and they, although deficient in linear growth, mature normally towards Down's syndrome adulthood.

The investigation of Pozsonyi et al. (1964) on skeletal maturation in Down's syndrome showed retarded bone growth up to 8 years of age. Beyond this age bone growth accelerated in advance of the theoretical norm until 15 years of age. The termination of skeletal growth in Down's syndrome is at approximately 15 years, which is 3 years in advance of normal expectation. This suggests an aging process which is more rapid than the theoretical normal one.

The investigation of Rundle et al. (1972) shows that the nature of the growth process in Down's syndrome is non-linear. The point of intersection of eight years agrees with the data of Pozsonyi et al. (1964), but unlike the latter, Rundle et al. were unable to detect any significant advance or sex difference suggested by Menghi (1954).

Rundle et al. state the need for a longitudinal study of bone development in a group of subjects with Down's syndrome from birth to completion of growth, correlating the skeletal changes with concomitant changes in the endocrine system, and relating the degree of abnormality with mortality patterns.

More detailed anthropometric measurements with Down's syndrome subjects are reported in the studies of Mosier et al. (1965) and of Thelander & Pryor (1966), which in fact have been the main sources of reference for the present study.

In a cross-sectional survey of ten physical measures carried out on 2472 institutionalized mentally retarded patients Down's syndrome has been a separate diagnostic category (Mosier et al. 1965). The results of the Down's syndrome group compared with the other diagnostic categories are as follows:

- The mean curve of weight for DS showed an adolescent weight spurt beginning around 15-16 years instead of 12 years as in the other diagnostic categories.
- The DS cases were shortest and less variable in height.
- In stem height the DS group was similar to the total group.
- In symphysis-heel height DS cases were much shorter than the total group.
- No differences between the total and DS groups were found in biacromial diameter, in bicristal diameter and in chest circumference.
- In head circumference DS cases had means significantly smaller than other groups.

- In head A-P diameter the mean values of the DS group fell one or more standard deviations below the normal.
- In head B-P diameter DS cases did not differ from the other categories in contrast to the A-P diameter results.

Graphs from growth studies on normal children, 6000 boys and 6000 girls, constituted the backdrop for the growth evaluation of 146 Down's syndrome children in the study of Thelander & Pryor (1966).

Growth curves showed the following characteristics for children with Down's syndrome:

- They were consistently below normal range for standing height at all ages and became relatively shorter each year up to 15 years of age.
- Their heads were small and ceased to grow after two and one-half to three years of age. There was a greater deficit in cephalic length than in cephalic breadth.
- Ear length was dwarfed at every age. Vestigial ears were practically universal.
- Dimensions of the face lagged in both height and width. The DS cases retained their round baby faces.
- Trunk diameters and sitting heights were close to the normal range for each age-sex group. Shortness of stature, then, was due to failure of their legs to grow in normal fashion. This represents persistence of infantile body proportions.
- Width-length indices of body build consequently classified them all as stocky.
- Boys were more variable than girls in all the measurements.

The physical growth studies mentioned above have been cross-sectional and based on differences in univariate analyses. There have been neither cross-sectional nor longitudinal multivariate analyses of the growth dimensions of factors with DS cases and there is no knowledge of possible differences in these factors between DS and non-DS groups and of how growth factors are related to other behavioral measurements in the both above mentioned groups.

1.4. Measured intelligence

1.4.1. Measured intelligence in mental retardation

The one-dimensional and global IQ-description of intelligence has its origin in the field of mental retardation, but it is no more adequate to characterize the intellectual ability structure in such a way, although it is still quite common. After the studies of Thurstone factor hypothesizing and factor structure seeking studies have clarified the role of differentiated ability factors, which are more adequate measures than global IQ to describe the intellectual capacities of mentally retarded individuals.

The studies of Meyers et al. (1962, 1964) are the first in which the factor structure of the intellectual abilities of normal and retarded children, 2, 4 and 6 years of age have been investigated. Also Kebbon (1965) compared the normal and retarded structure of abilities. Kebbon showed that the mentally retarded have the same abilities as normals and that their abilities are organized in the same way as in normals. He studied these problems with mildly retarded adults.

The studies of Meyers et al. (1962, 1964) have been replicated among others by Frank & Fiedler (1969) and by the present author (Kääriäinen (1970a). The same factors remain largely intact even when embedded in a wider behavioral context, examined in different mental retardation populations and when extracted and rotated by diverse methods.

1.4.2. Measured intelligence in Down's syndrome

The earlier studies concerning the intellectual characteristics of the DS are reviewed by Johnson & Olley (1971). Most of these studies have been univariate analyses and based on IQ measurements. The reviewers state that the studies inspected give little evidence that the retarded individual's behavior in the majority of experimental tasks is related to his medical classification of DS.

Reinecke (1972), Eggert (1970), Frank & Fiedler (1969), and the present author (Kääriäinen 1970a, b, 1972a, b) have published investigations which are not reported in the review of Johnson & Olley (1971) and which compare the intellectual characteristics of Down's syndrome and non-Down's syndrome subgroups of retarded subjects.

The purpose of the investigation of Reinecke was to determine whether there are cognitive differences between children with Down's syndrome and children with mental retardation on unknown etiology. It was hypothesized that there are specific cognitive abilities which differentiate these two diagnostic groups. Additionally, it was hypothesized that the development of specific cognitive abilities of children with Down's syndrome tends to proceed more evenly than does that of non-Down's syndrome children. Mentally retarded children between the ages of five and fourteen were used as subjects. The Stanford-Binet Intelligence Scale was used to measure cognitive functioning. Responses to the S-B were classified according to Lutey's schema for dividing the items of this instrument into 13 specific cognitive areas. In order to determine the degree of variability in the level of the subject's responses, the range between the basal and ceiling ages of the S-B was used.

Step-wise discriminant analyses were used to test for differences between the diagnostic groups on the 13 areas of cognitive functioning. One-way analyses of variance were used to determine whether there were differences between the diagnostic groups in the degree of variability within each subject's performance.

No significant differences were found between the two groups on any of the 13 cognitive areas at any of the three age levels or for the total sample. Additional analyses indicated a high degree of intercorrelation between the areas of cognitive functioning used in this study. The subjects with Down's syndrome had a significant shorter range between their basal and ceiling ages and also passed fewer items above their basal age level.

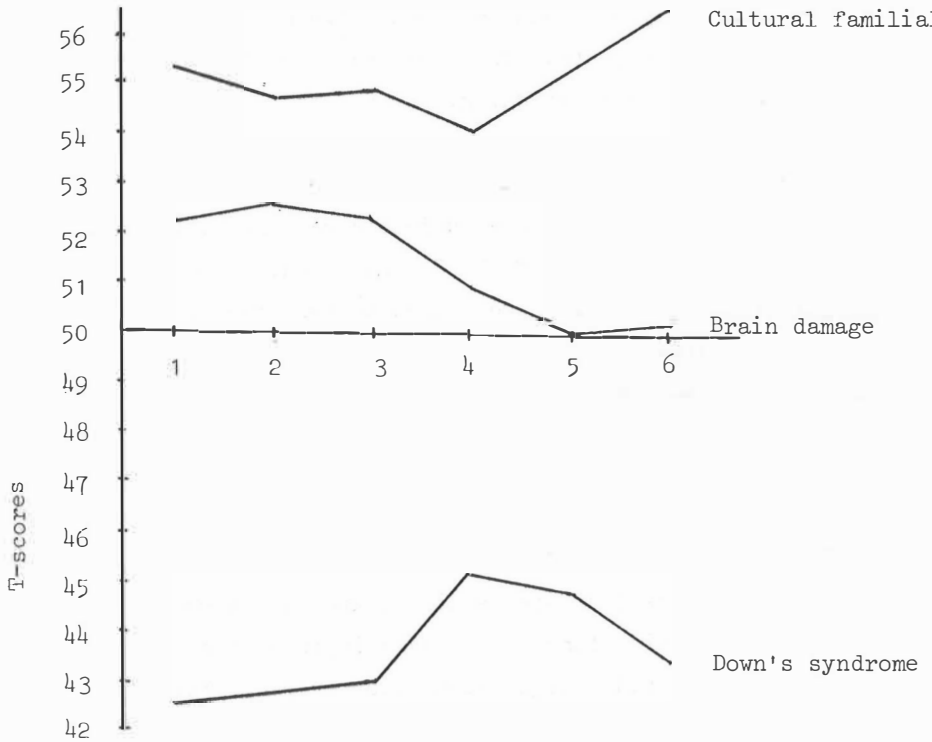
On the basis of the discriminant analyses, it was concluded that the hypothesis that there are specific cognitive differences between these two diagnostic groups could not be confirmed. It was concluded that the two groups do no differ in the areas of cognitive functioning measured. It was also concluded that there does seem to be some difference between the two groups in the degree of variability in their individual performances, but that the data on this issue are somewhat conflicting.

The only weakness of Reinecke's study is that it does not use well motivated and uncorrelated ability factors as areas of cognitive functioning.

Of the studies concerning possible intellectual differences between Down's syndrome and other diagnostic groups in mental retardation the one by Eggert (1970) is the most consistent. It compares the test results of

231 subjects in the test battery of six intelligence tests and between the diagnostic groups of Down's syndrome, brain damage, and cultural-familial mental retardation. Each of the above mentioned subgroups consisted of 77 subjects.

In the comparison of the global profiles there were significant differences between Down's syndrome, brain damage and cultural-familial groups as seen in the following Figure 1 (Eggert, p. 63):



1 = Columbia Mental Maturity scale
2 = Raven
3 = Peabody Picture Vocabulary Test
4 = Following directions
5 = Dotting test
6 = Lincoln-Oseretzky

Figure 1. The test profiles of the three groups on six tests

There were only two factors in the factor analysis of the total group, general performance level and psychomotor. The discriminant analysis with the factor scores gave significant discriminations between the discriminant scores of the three groups.

The Lincoln-Oseretzky Motor Development Scale had the greatest relative contribution to the discriminator. The Columbia Mental Maturity Scale and the Peabody Picture Vocabulary Test had the next highest contributions to the discriminator. The brain damage group was most heterogenous according to the discriminant scores.

The anamnestic data, height and weight and social competence measures with the shortened Vineland Social Maturity Scale were also collected, but not completely for the total sample.

The Down's syndrome group was smallest in height (mean = 129.7 cm) and also in weight (mean = 30.7 kg). In the shortened Vineland scale the Down's syndrome group had the lowest mean scores of social maturity.

The same weakness as in the study of Reinecke applies to the study of Eggert. There are not sufficient and adequate factor tests in the intelligence test battery. The results, however, are consistent with the results of the present author (Kääriäinen 1972a) on the role of the psychomotor factor, which distinguishes the Down's syndrome group from the other types of mental retardation. The diagnostic groups in the study of Eggert were heterogeneous in regard to the mental age level of the subjects.

The study of Frank & Fiedler (1969) was designed to explore the feasibility of distinguishing among subtypes of mental retardation on the basis of observable behavior. The major focus was upon discrimination between subjects whose low IQ could be attributed to normal polygenic segregation and those subjects whose deficiency was attributable to chromosomal or single locus genetic defects. Concurrently the study sought to distinguish among diagnostic subgroups of the second category. The sample included 15 Down's syndrome cases, four PKU (phenylketonuria) cases, and ten presumed polygenic segregants, who have been collectively called undifferentiated. All these subjects were in residential care. The chronological ages ranged from five years to 51 years and most of the subjects were adolescents or young adults. The mental age varied from 4.5 to 7.5 years. The study included an attempted replication of earlier work by Meyers et al. (1964) exploring four of Guilford's intellective factors in a mental retardate population. Two factor analyses were run on the test battery. The first 26-variable solution was based on subscale scores and the second 15-variable solution on scale totals. With a few important differences the 26-variable solution replicated the first-order factor solution of the earlier study (Meyers et al. 1964), while the 15-variable solution approximated to the

second-order solution obtained by Meyers et al. (1964). The ten factor scores derived from the 26-variable solution were utilized in a multiple discriminant analysis to determine the degree of discrimination among diagnostic groups. Discriminant functions based on a subset of five of the factor scores discriminated between groups in all three pairwise comparisons at the .05 level. The study indicated the necessity of including a wider variety of behavioral domains than has been the practice in previous efforts to generate factorial diagnostic indicators.

The sample in the study of Frank & Fiedler was too small for consistent conclusions, but the analyses included in the design of their study have been appropriate.

The present author (Kääriäinen 1970a, b) has shown significant differences in four ability factors between the groups of DS and undifferentiated severely and moderately mentally retarded subjects. The computerized generalized analysis of variance in four dimensional criterion scape showed a highly significant difference ($p < .005$) between these groups. To investigate further the possible differences in patterns between the above mentioned subgroups sampling error adjustments were made with covariance analyses in order to make the subgroups more comparable than in the earlier analyses (Kääriäinen 1972a, b). The sample consisted of 80 subjects of which 24 were DS cases and 56 non-DS cases. After the covariance adjustments only the psychomotor factor showed a significant difference ($p < .02$) between the subgroups. In the discriminant analysis the psychomotor, memory-quantative, and visual perception factors had the greatest relative contribution to the discriminator. The direction of discrimination of the visual perception factor was opposite to the other ability factors. After the covariance adjustments the visual perception factor was also the only ability of the DS group with a higher mean value than the same ability of the non-DS group. The results supported the earlier findings of O'Connor & Hermelin (1961) obtained in univariate analyses in visual perception differences and earlier results of Berkson (1960) and of O'Connor & Hermelin (1963) in reaction time, in motor speed and in motor control experiments between the above mentioned subgroups.

The differences in patterns obtained supported the special nature of the ability structure of Down's syndrome.

Of the earlier studies reviewed here it can be seen that some univariate analyses but especially factor hypothesizing studies have shown pattern differences in intelligence between the DS and non-DS groups.

These differences are seen most consistently in psychomotor, but also in visual perception factors. In global IQ analyses differences are usually not found between these groups.

1.5. Personality traits

1.5.1. Research on personality structure in the retardate

Ziegler (1966) has reviewed the research on personality structure in the retardate. Many of the reported findings are very recent and reveal that research traditions in this field are not old.

Research in mental retardation has underlined many aspects already in the definition of mental retardation and personality and postulated many defects which retardates suffer. These are according to Ziegler (p. 77):

1) a relative impermeability of the boundaries between regions in the cognitive structure
2) primary and secondary rigidity caused by subcortical and cortical malformations, respectively
3) inadequate neural satiation related to brain modifiability or cortical conductivity
4) impaired attention-directing mechanisms
5) a relative brevity in the persistence of the stimulus trace
6) malfunctioning disinhibitory mechanisms
7) improper development of the verbal system resulting in a dissosiation between the verbal and motor systems

This difference orientation, as Ziegler it calls, assumes that all retardates regardless of etiology are viewed as inherently different. In respect to the familial retardate, however, no convincing physiological evidence has been found indicating the presence of any of the defects noted above. These defects have been postulated on the basis of differences in performances between retardates and normals. An assumption is also made that these differences in performances are the product of the cognitive structure or intellectual level alone. These performance differences are, however, a multiply-determined phenomenon, influenced by cognitive, motivational and emotional factors (Ziegler, p. 78).

The review by Ziegler of research on personality structure in the retardate has led him to the following six hypotheses or conclusions (Ziegler, p. 103-104):

1. Institutionalized retarded children tend to have been relatively deprived of adult contact and approval, and hence have a higher motivation to secure such contact and approval than do normal children.
2. While retarded children have a higher positive-reaction tendency than normal children, due to a higher motivation to interact with an approving adult, they also have a higher negative-reaction tendency. This higher negative-reaction tendency is the result of a wariness which stems from retarded children's more frequent negative encounters with adults.
3. The motive structure of the institutionalized retardate is influenced by an interaction between pre-institutional social history and the effects of institutionalization. This effect is complicated by the fact that institutionalization does not constitute a homogeneous psychological variable. Instead, institutions differ, and underlying psychological features of the particular institutions must be considered before predictions can be made concerning the effects of institutionalization on any particular child.
4. The positions of various reinforcers in a reinforcer hierarchy differ as a function of environmental events. Due to the environmental differences experienced by institutionalized retarded children, the positions of reinforcers in their reinforcer hierarchy will differ from the positions of the same reinforcers in the reinforcer hierarchy of normal children
5. Institutionalized retarded children have learned to expect and settle for lower degrees of success than have normal children.
6. An inner- versus outer-directed cognitive dimension may be employed to describe differences in the characteristic mode of attacking environmentally presented problems. The inner-directed person is one who employs his own thought processes and the solutions they provide in dealing with problems. The outer-directed person is one who focuses on external cues provided either by the stimuli of the problem or other persons in the belief that such attention will provide him with a guide to action. The style which characterizes the individual's approach may be viewed as a result of his past history. Individuals whose internal solutions meet with a high proportion of failures will become distrustful of their own efforts and adopt an outer-directed style in their problemsolving. Since retardates unquestionably experience a disproportionate amount of failure they are characterized by this outer-directedness. Many behaviors that are thought to inhere in mental retardation, e.g., distractibility, may be a product of this cognitive style.

The psychological processes underlying these hypotheses operate in combination more often than in isolation.

Nyholm & Westholm (1971) have also reviewed the research of comparisons on the personality of normal and retarded subjects and have an empirical investigation to ascertain whether mentally retarded children exhibit the same structure of personality as normal children of the same age and whether sex differences are provable and how certain ability factors are related to the structure of personality.

The personality inventory and the personality rating scales were used and two groups of children were studied in respect to factors of personality and ability. In the construction of the rating scale the methods of Herard (1961) and of Straus & Kephart (1940) were used as a model. The mildly mentally retarded group consisted of 100 boys and 29 girls between the ages of 10 and 18 and with IQ's between 50 and 95. The control group consisted of 408 normal boys and 401 normal girls between the ages of 11-12 years.

The ability factors used were verbal flow, verbal, logical, spatial and numerical. The personality rating scale was used for the retarded group.

The normal children's structure of personality in the form of extraversion/introversion and neuroticism could be identified in the retarded group, both when factor analysis and principal component analysis were used, as well, though the social component of the variable of extraversion/intraversion was not as strongly manifested and the variable was more complex in the retarded than in the normal group. Concerning the degree of neuroticism in the two groups, the retarded children had significantly higher scores on the neuroticism scale and were more neurotic compared to normal children, and girls were more neurotic compared to boys in both groups.

Although mental retardation and emotional disturbances have no clear relationship with each other, emotional disturbances are more common among mentally retarded than among a normal or gifted population. When analysing the reasons for these more common disturbances it must be remembered that subnormals have more real difficulties in adaptive behavior in the community throughout their whole lives and also relatively more often live in residential care than the normal or gifted population.

Normal children seem to be significantly more extravert compared to retarded children, and boys were just a little more extravert than girls in the study of Nyholm & Westholm (1971). It seems as though retarded

boys and girls have a significantly greater tendency to lie, compared to normal children, and that girls get higher lie scores than boys.

In both groups the ability factors are relatively independent of the personality factors, but they are connected in a complex and presumably unsystematic way (Nyholm & Westholm 1971).

1.5.2. Research on personality structure in Down's syndrome

Since Langdon Down's original description of the syndrome (1866) a vast amount of attention has been given to the physical aspects of the condition, but little space has been devoted to the emotional and behavioral aspects of the syndrome.

Before the investigations by Rollin (1946) and by Blacketer-Simmonds (1953) most observers only agreed with standard textbook descriptions of the syndrome without closer observations and statistical evaluations. An interesting historical review since the first description of the syndrome is made in the study of Blacketer-Simmonds (1953).

Several studies with the main focus on the physical aspects have stated that Down's syndrome cases exhibit certain mental and emotional traits which are nearly as characteristic of the type as are the physical stigmata (Brushfield 1924, Brousseau & Brainerd 1928, Penrose 1933, Tredgold 1947, Benda 1946).

A general impression is that Down's syndrome cases are almost invariably lovable with very attractive peculiarities and few if any of the bad behavior traits and undersirable habits so commonly found among other defectives.

In the study of Rollin (1946) seventy-three cases of DS in residential care were examined. Behavior disorders both before and after admission were noted in 60.2 per cent of the subjects. The disorders were similar in nature to those occurring in other defectives of the same intellectual level.

The Down's syndrome cases were classified into three typological groups, introvert, extravert, and mixed. Introversion was surprisingly singly common and was noted in 42.4 per cent of the subjects. A catatonic psychosis is described as occurring in 23.3 per cent of the subjects.

In the study of Blacketer-Simmonds (1953) Down's syndrome cases in residential care were compared with control subjects which were chosen to match as closely as possible intellectually and physically the Down's syndrome cases. Blind subjects, epileptics, hemiplegics, and others showing

clinical evidence of gross brain lesions together with all those with a history of cerebral inflammatory disease, were rejected.

First information was collected regarding the temperamental peculiarities of the subjects as they had appeared to those who had observed them before admission to residential care. The differences in three of the traits investigated were significant. DS cases were shown to be less docile, more solitary, and more mischievous than the control group. The non-significant differences do not tend to favour the DS group. In this comparison there were 140 DS cases and 100 control subjects.

Another phase of this investigation was made with 60 DS cases and with 300 control subjects. It was made by means of a questionnaire among the members of the nursing staff. The nurses were requested to indicate, by a "+" against the names of the patients, those showing to a conspicious degree the traits named in the questionnaire. No significant differences were shown between the groups in 12 traits.

In the last phase of this investigation a test was designed to examine general response to music, sense of rhythm, timing, and sense of tune. Forty-two cases of DS were compared with the same number of control subjects in these tests of music and rhythm. No significant differences were observed between the groups.

Blacketer-Simmonds concludes that DS cases do not generally conform to any characteristic temperamental type or types, and that no significant differences may be observed between them and the control group with regard to the character-traits investigated or their response to music and rhythm.

Similarly, Cantor & Girardeau (1959) did not find support for a marked sense of rhythm in Down's syndrome.

The study of Baron (1972) showed that the behavioral characteristics of 18 DS children all living at home are comparable to those of normal children, demonstrating that in early life the child with DS is not stereotyped in behavior.

All other studies reviewed here, comparing DS with control subjects on the same MA and CA levels, have shown that DS cases are stereotyped in behavior.

Silverstein (1964) states that the stereotype of the DS as a well-adjusted, extraverted individual can be traced back almost 100 years, and it can be found with only minor variations throughout the literature on mental retardation. In his study Silverstein employed matched groups, continuous ratings, and an analysis of variance approach to his data.

In the two factors of the Peterson's Behavior Rating Schedule, the DS group scored significantly higher than the controls on the general adjustement factor. On the introversion-extraversion factor the scores for the two groups did not differ significantly. The findings provided partial support for the stereotype of the DS.

The results of the investigation of Domino (1965) strongly suggest that DS cases in residential care do exhibit a constellation of personality traits which can be recognized even by untrained observers.

In his investigation Menolascino (1965) states that, although the stereotype of the DS as a charming lovable retardate may be accurate, he is by no means immune to psychiatric disturbances. Of the 86 cases of DS, 11 were felt to have psychiatric problems by the clinical staff.

Moore et al. (1968) found DS cases to show significantly less maladaptive behavior on 14 of the 21 rated behaviors. In his study 536 DS cases residing in institutions were matched with 536 control residents without DS and compared in terms of maladaptive behavior. The study supports previous investigations, which have concluded that retarded individuals with DS, as a group, tend to exhibit less maladaptive behavior than retarded peers without DS.

Tatekawa (1967) has also presented empirical evidence that the personality of children with DS represents a characteristically definable trait constellation. A later study by Tatekawa (1969) attempted to find out the relationship between intellectual level and personality traits. He divided 87 DS cases and 150 control subjects in two groups according to the results of an intelligence test. Analyses of the differences in the Personality Check List indicated that 14 of the 40 rated items differentiated the two groups. These items seem to be closely related with the intellectual level of the DS.

Cytryn (1972) studied the onset of attachment behavior in 76 infants with DS. Attachment is one of the terms commonly used in psychiatric and psychological literature to denote a number of special-characteristic behaviors serving to bind the child to his mother. The onset of attachment behavior characteristic of the first six months of life was only slightly delayed as compared with normal infants. However the attachment behavior normally occurring in the second half of the first year of life did not begin until close to the end of the second year in about 85 per cent of the sample. In the remainder the onset of this behavior was only slightly delayed. The investigation of this group revealed in each case an

exaggerated maternal involvement with the baby due to exceptional life circumstances such as life-threatening disease of the child, marital crisis or a strong feeling of guilt. The analysis of the findings throws light on the respective roles of intellectual functioning, maternal involvement and parental attitudes in the origin of human attachment patterns.

In their study Cytryn & Rubin (1972) criticize the earlier investigations for the stereotype of placidity, cheerfulness and relative absence of behavioral disturbances in children with DS, which have been challenged by several investigators who claim that these children carry a similar risk of behavior disturbances as the children with other forms of mental retardation. This controversy is complicated by the frequent use in such studies of biased samples, consisting of institutionalized patients or those referred to a psychiatric clinic. In the study of Cytryn & Bubin an entire population of a private nursery school system for the mentally retarded, 21 DS cases and 25 other forms of mentally retarded was rated by the teaching staff on a 4 point scale on seven types of behavior disturbances, commonly seen in mentally retarded children: hyperactivity, aggression, lack of cooperation, withdrawal, lack of relatedness, irritability, and impulsivity. Speech development was similarly rated on a 4 point scale.

The children with other forms of mental retardation showed significantly more disturbance than those with DS on 4 of the 7 variables:

Withdrawal	$p < .01$
Lack of relatedness	$p < .05$
Impulsivity	$p < .01$
Irritability	$p < .02$

These differences may be due to constitutional factors, social learning patterns or a combination of the two (Cytryn & Rubin 1972).

In their study, Schlottman & Anderson (1973) had 6 male and 6 female children with DS, who interacted in dyads in sexually homogeneous and heterogeneous free-play situations. Actual, observable behaviors were recorded to investigate sex differences in, and the influence of sex of peer on, social and play behavior. Girls engaged in more sedentary activities than boys and sexual homogeneity resulted in fewer sedentary activities than sexual heterogeneity. Peer-sex seems to influence the type more than the amount of social interaction with male DS cases being more influenced by peer-sex than girls. The results also suggest that the

stereotypic conception of the DS as cheerful and friendly seems more appropriate in describing the behavior of male DS cases, as far as their play with peers is concerned.

As seen from the studies reviewed above, there is a controversy between the studies which underline the stereotype behavior and absence of behavioral disturbances in DS and studies which claim that DS cases carry a similar risk of behavioral disturbances as other forms of mental retardation and are not stereotyped. Biased samples consisting of institutionalized patients or those referred to a psychiatric clinic and the age differences complicate these investigations. Obtaining a representative sample of DS cases is usually too complex or impossible a process for the investigators. The rating technique has been mostly used as a method for studying the personality structure of retardates. It estimates the subject only in a certain situation and in a definite role in which the rater is also involved. Another source of error in the rating technique is the personality and intellectual differences of the raters (Cattell 1965).

1.6. Adaptive behavior

1.6.1. Research on adaptive behavior in the retardate

Adaptive behavior refers primarily to the effectiveness of the individual in adapting to the natural and social demands of his environment. The term was joined to the definition of mental retardation by the expert committee of A.A.M.D. (1959). Impaired adaptive behavior may be reflected in maturation, learning, and social adjustment. These three aspects of adaptation are of different importance as qualifying conditions of mental retardation for different age groups.

The primary classification of A.A.M.D. makes use of two dimensions, measured intelligence and adaptive behavior. It is not intended to suggest that adaptive behavior and measured intelligence are completely independent dimensions. Though intelligence test scores and level of adaptive behavior are related, there will nevertheless be a sufficient number of discrepancies in level of performance on the two dimensions to justify the dual classification. These discrepancies will be particularly common in adolescents and adults with mild degrees of retardation in measured intelligence. Such discrepancies, whenever they do occur, are of significance in educational, social, and vocational planning and prognosis.

A wide range of specific abilities and disabilities contribute to the total adaptation to the environment. The development of adequate measurement techniques for adaptation at various age levels is a complex task because the behaviors used to evaluate adaptive behavior are different for various age levels and the norms and standards to which adaptive behavior refers are incomplete and inconsistent. These norms vary at successive ages from birth to adult life and are determined in part by developmental norms which reflect the decreasing dependence of the child and, in part, by the culturally and socially imposed standards of acceptable behavior (A.A.M.D. 1959).

The efforts directed to develop suitable measurement techniques are reviewed by Leland, Shellhaas, Nihira,& Foster (1967). There are also other reviews of the present topic, such as those by Haywood & Tapp (1966), by Ericsson (1972), and by Balthazar (1972).

In view of the later findings in the studies of Nihira (1969a, b), and Foster & Nihira (1969), the unidimensional classification system of adaptive behavior proposed in the A.A.M.D. manual seems inadequate as a classification tool and insufficient as a descriptive concept.

Balthazar & English (1969a) made a factor analysis of coping behaviors in a residential population of 288 more severely mentally retarded subjects. 18 factors emerged from the study. Each factor represented a behavioral domain within which individual members of the sample responded in a consistent manner. The factors were established from 71 subscale items. Emphasis in the study was restricted to establishing factor scales in order to identify the behaviors prior to using them for grouping or classification purposes. In a later study (Balthazar & English 1969b) the major objective was to develop a classification system of the social behaviors of more severely mentally retarded individuals.

The studies of Nihira (1969a, b) were attempts to explore the basic parameters of adaptive behavior and the primary dimensions along which retardates differ from one another in coping with their environment. Objective descriptions of the coping behavior of 919 adult institutionalized retardates were obtained by means of developed behavior rating scales. A factor analysis of 22 variables representing 10 behavioral domains in personal independence and 12 behavioral domains in personal and social responsibility delineated two major dimensions, personal independence and social maladaptation. They accounted for approximately 77 per cent of the total individual difference. The personal independence factor may be

similar to the traditional notion of social competence as measured by the Vineland Social Maturity Scale. The social maladaptation factor is a general dimension of social maladaptation, which indludes destructiveness, rebelliousness, untrustworthiness, anti-social behaviors and manners, and personality problems indicating various negative attitudes toward the social environment.

The later study of Nihira (1969b) strongly indicated that personal independence and social maladaption factors are mutually independent dimensions in the heterogenous group of retardates, and that the factors are invariant across a wide span of age range from the pre-adolescent period through adulthood.

The results of the studies of adaptive behavior in the retardate described above indicate that the factor of personal independence is similar to the traditional social competence measures and the social maladaptation factor is similar to the ratings where anti-social behaviors and personality problems indicating various negative attitudes toward the social environment are included.

1.6.2. Research on adaptive behavior in Down's syndrome

There are no investigations of the adaptive behavior described in the earlier chapter and carried out with Down's syndrome subjects. Instead of these are some investigations where traditional social competence scales have been used with DS subjects and the results are compared with a group with other forms of mental retardation.

In the study of Cornwell & Birch (1969) the data of 44 home-reared children with DS on the Standford-Binet and on the Vineland Social Maturity Scale revealed a broad range of both intellectual and social competence. IQ scores decreased with age, whereas SQ scores did not decline as systematically. The age-specific patterns indicated a slow accretion of certain social functions and concomitant impoverishment in advanced social skills. Severe limitations in language and conceptualization were noted throughout. The data supported the hypothesis that in DS there is both a developmental lag and an arrest of certain psychological and social capacities.

The sample in the study of Johnson & Abelson (1969) consisted of 2606 individuals with DS which were compared with 20605 non-DS mentally retarded in the 1967 regional census on the general level of behavioral

competence. The mean age of the DS cases was 21.18 and for the remainder of the census population it was 24.45. The mean IQ of the DS cases was 28.61, and for the remainder of the sample it was 32.07. The DS cases were somewhat younger and duller than those in other diagnostic categories, but the differences were relatively slight. The two groups were compared for the frequency with which they exhibited the following behaviors, all of which pertain to areas of social comptence: dresses self, communicates to others understandably, understands others, brushes own teeth, feeds self with knife, fork and spoon, grooming- stays neat, independent use of toilet, never or infrequently wets the bed, is candidate for ward helper or work project, and is on work reward system. The DS group showed a higher per cent of socially adaptive, socially competent behavior in seven of the eleven comparisons despite the fact that they were slightly younger and duller than the group with which they were compared. The differences in favour of the DS cases were large in the area of selfhelp and either small or non-significant in the area of helping others. A striking departure from the general tendency for DS cases to be more competent than the comparison group is found for the item "communicates to others understandably". This item showed the largest difference of any of the comparisons, and here the DS cases were inferior. This finding is in general agreement with the investigation reported by Spreen (1965).

When comparing a DS and a control group Lindgren (1972) did not find significant differences in social age, SQ, communication and self-help dimensions between the groups. The only significant difference was in emotional development.

Of the studies of social competence in DS compared with other forms of mental retardation and reviewed here, the study of Johnson & Abelson (1969) is widest and confirms other consistencies reported in the literature.

2. PROBLEMS OF THE PRESENT STUDY

The chromosomal nature of the DS as a first chromosomal abnormality of the human being makes it an extremely interesting object of research also to the behavioral sciences and to clinical psychology. It would be important

to determine whether this syndrome does exist as a particular psychological entity which differs systematically from other types of mental retardation even in measurable behavioral dimensions. What are the relationships of the possible behavioral differences to the typical and better known physical effects of this syndrome?

This kind of mapping of the known syndromes in mental retardation has both theoretical and practical implications.

Of the background variables besides the DS, differences in sex and in type of care were also investigated, but not with the same intensity as the DS variable. The analyses of the sex variable would have required more subjects of both sexes in the DS and control groups than was the case. The study of the effects of type of care (open, residential) would require the collection of different social background data, which has been outside the scope of the present study. There are several inconsistent and selective social and other decisions when institutionalizing a retarded individual which reduce the representativeness of an institutional sample and make the type of care variable not especially suitable for further analyses. For the above reasons the analyses of sex and type of care variables were only tentative.

Because the nature of the multivariate analyses is heuristic (Cooley & Lohnes 1971, p. 5), a study such as the present one was not directed towards hypothesis testing although the heuristic and hypothesis testing functions are usually intertwined. Precise hypotheses were not deduced, because in every measurement areas there was not sufficient advance knowledge of how many and what kind of factors were extracted.

The possible differences between the groups studied were considered significant, if they were at levels between $p < .01 - .001$ and nearly significant, if they were at levels between $p < 0.5 - .01$.

The following hypothesizing questions were deduced from the different measurement areas. After these questions, procedures for examinations were presented:

1. Which are the main operationalistic dimensions or factors of measured physical growth, of measured intelligence, of rated personality traits, and of rated social competence among severely and moderately mentally retarded DS and non-DS subjects, male and female, between the chronological age of 12 and 20 years, and residing in open and residential care?
Procedure: An examination of the main dimensions or factors in each measurement area with the help of factor analyses.

2. Are there significant differences between the DS and non-DS groups in measured physical growth, in measured intelligence, in rated personality traits and in rated social competence? If so, which factors in each area discriminate best between the groups studied?
Procedure: An examination of the possible differences between the DS and non-DS groups in discriminant analyses. These analyses include: a) factors from each measurement area b) all measured factors from all areas.
3. Are there differences between the discrimination powers of the different measurement areas? If so, which areas discriminate best between the groups studied?
Procedure: An examination and comparison of the discrimination powers of each measurement area.
4. Which of the measured physical growth, intelligence, personality trait and social competence factors are included in the optimally discriminating combination of factors, when the number of factors is reduced so that the difference in discrimination power of the best combination and of the solution with all factors is not significant?
Procedure: An examination of the best discriminating combination of all measured factors of all areas.
5. What are the relationships across the different measurement areas? Is there any overlap between the measurement areas?
Procedure: An examination of the relationships across the different measurement areas with the help of canonical correlation analyses.
6. How do the group mean differences change when the accuracy of the comparisons is increased with covariance analyses?
Procedure: An examination to increase the efficiency of designed experiments with statistical means using sampling error adjustments in covariance analyses.
7. How accurate is the classification between the groups studied with the help of the measured factors within each measurement area and with all factors measured?
Procedure: An examination of the classification probabilities between the groups studied and using: a) factors from each measurement area b) all measured factors from all areas.
8. Which of the measured factors are included in the most discriminating factor combination when analysing possible sex and type of care differences? What are the discrimination powers of the sex and type of care variables when compared with the discrimination power of the DS variable?

Procedure: A preliminary examination of the background variables of sex and type of care and a comparison of the discrimination powers of the background variables of DS, sex and type of care.

3. METHODS

3.1. Physical growth

The measurements of physical growth were also included in the present research design, because differences in this area have been observed earlier in univariate analyses between the groups studied. The possible behavioral differences were thus anchored in the traditional and reliable anthropometric measurements and could be compared with each other by their discrimination powers. The selection of the anthropometric measurements used were done according to the findings in the earlier univariate studies. They were the measurements of head, face, body and girths. The technical performance was planned according to Montagu (1960) and with the help of the studies of Takkunen (1962) and Haataja (1963).

The instruments necessary for the somatometric measurements were a spreading caliper (Gneupel), and anthropometer (GPM), a cloth tape-measure graduated in millimeters and a weight beam scale.

The twenty measurements selected were defined as follows:

Head:

5. Maximum head length (spreading caliper). The distance between the glabella and the farthest projectig point in the mid-sagittal plane, on the back of the head (occiput).

6. Maximum head breadth (spreading caliper). The greatest transverse diameter of the head. This is usually found at the point over each parietal bone.

7. Maximum circumference of the head (tape). From the smooth area between eyebrows (glabella) around the maximum projection of the occiput to the glabella. The hair is included in the measurement, except in cases where it is unusually thick.

8. Cephalic index: $\frac{\text{breadth} \times 100}{\text{length}}$

Face:

9. Bizygomatic breadth (spreading caliper). The distance between the most laterally situated points on the skin of the zygomatic arches.

10. Bigonial breadth (spreading caliper). The distance between the gonial points which are the most lateral points on the skin upon the postero-inferior angle of the mandible.

11. Morphological facial height (anthropometer). From nasion to gnathion.

12. Facial index: $\frac{\text{morphological facial height x 100}}{\text{bizygomatic breadth}}$

Body:

13. Standing height (anthropometer). The distance from the highest point of the top of the head in the mid-sagittalplane to the floor.

14. Weight (weight beam scale). Naked. The adult male subjects wore light shorts and adult females wore a bra and panties. To arrive at a correct naked weight, 100-500 g was deducted from the values.

15. Index: $\frac{\text{height x 100}}{\text{weight}}$

16. Sitting height (anthropometer). The subject sits erectly with the head in the plane of the visual axis on a bench or table, high enough to keep the subject's feet away from the ground. From the highest point, in the sagittal plane, of the head to the surface upon which the subject is seated.

17. Skelic index: $\frac{\text{height - sitting height x 100}}{\text{sitting height}}$

18. Span (anthropometer). The distance between the tips of the middle fingers of each hand when the arms are outstretched sidewards horizontally from the body measured from behind.

19. Index: $\frac{\text{span x 100}}{\text{sitting height}}$

Girths:

20. Axillary chest girth (tape). The tape applied well up in the axillary fossae. Mean reading of measurements during normal inspiration and expiration.

21. Minimum circumference of the trunk-waist girth (tape). Mean of measurements during normal inspiration and expiration.

22. Maximum circumference of the right thigh (tape). Perpendicular to the long axis of the thigh, with the tape in the gluteal fold.

23. Maximum circumference of the right forearm (tape). Immediately distal to the elbow joint, with the hole extremity hanging relaxed at the subject's side.

24. Index: $\frac{\text{axillary chest girth} \times 100}{\text{sitting height}}$

All the measurements were carried out by the author assisted only by the ward personnel in the measurement of span. The reliability of the anthropometric data varies with the structure of the body measured. The results for thin subjects are more reliable than those for fat subjects (Takkunen, p. 27). If the same person performs the measuring work, the measurements with the smallest percentage errors were, in the studies of Takkunen and Haataja (p. 29 and 23 respectively), head measurements and height (under 0.3 %). Other dimensions for which the measuring error was under 1 per cent were thoracic circumference, bicristal breadth and sitting height.

3.2. Intelligence

A test battery with four hypothetical intellectual factors and with ten tests was selected and partly constructed by the present author according to earlier experiences of the factor structure at the same mental level (Kääriäinen 1970a). There were significant differences in four ability factors between the DS and non-DS groups in this study. The results of the DS cases in other tests (Clausen 1968) and in the learning variable (Kääriäinen 1970b) could not be explained without postulating the existence of compensatory mechanisms in the DS group. The later analyses of the author (Kääriäinen 1972a, b) showed the special nature of the ability structure in DS. The hypothetical factors in the present study were therefore in line with the earlier findings:

- Visual perception
- Memory (short-term)
- Psychomotor (hand-eye coordination)
- Verbal general

One of the requirements of the test battery used was that it should not be too long and time consuming for retarded subjects. Therefore, the number of tests was limited to ten. For the memory factor a short-term memory test was constructed especially for this study. All the tests used in the test battery are described in detail in the Appendix, which also presents the reliabilities of the tests used. The tests in the hypothesized visual perception factor were:

- Block Design Modification (Wechsler PPSI)
- Identical Pictures (Thurstone & Thurstone)

- Pacific Pattern Copying (Meyers et al. 1962)
- Raven (Coloured Progressive Matrices, Set A and Ab)

The Block Design is in the WPPSI series and the form here used was a modification by the present author of the original test. The modification was made to give the scale enough easy items. The same modification was also used in the earlier study by the author (Kääriäinen 1970a).

The Identical Pictures test is in the K-1 part of the PMA-series of Thurstone & Thurstone (1954) and was used earlier with mentally retarded by Meyers et al. (1962, 1964) and also by the present author (Kääriäinen 1970a). The Pacific Pattern Copying test and Raven were also used in the studies mentioned above. All these tests showed high factor loadings on the visual perception factors with severely and moderately mentally retarded subjects.

The tests used in the hypothesized short-term memory factor were:
Auditory-Vocal Sequencing Test (ITPA)
A Visual short term memory test developed by the author

The short-term memory test was constructed because the memory factor in the earlier study of the author (Kääriäinen 1970a) did not absorb the Visual-Motor Sequencing Test (ITPA) and because short-term memory for figural-semantic units has been demonstrated by the studies of Orpet & Meyers (1966) and of Carlson & Meyers (1967), which have found support for two or more short-term memory factors.

A short-term memory factor orthogonal to other abilities is also demonstrated by the studies of Kebbon (1964), Kelley (1928), Loeffler (1963), and McCarthy & Kirk (1964).

The study of Ellis (1970) showed that the span of attention consisted of the processes secondary memory and primary memory and that only secondary memory varied with intelligence. It paralleled general mental development. Recognition memory of the type studied by Scott (1971) was fundamentally different from the memory for position studied by Ellis (1970).

The test constructed was designed to sustain the attention of mental age levels of 4-6 years and according to the model of the study of Atkinson & Hansen (1964). It consists of eleven items with coloured pictures for memorizing.

The material of the pictures used consists of memory play cards containing coloured pictures of familiar objects. On each item a subset of cards was randomly selected, and these were shown one at a time to the subjects. After each card was shown to the subject, it was placed face down on the table so that after all the item cards had been presented,

they formed a horizontal row in front of the subject. After the last card of the item in question was laid down, a cue card identical to one of the cards presented on that item was placed face up on the table, and the subject was asked to turn up the card which he thought matched the cue card. When incorrect, the subject continued to turn up cards until he located the correct one. The subject was not asked to name the cards. Each card was shown for two seconds.

The number of cards on each trial varied as follows:
(1) 3 (2) 4 (3) 5 (4) 6 (5) 7 (6-11) 8

The location of the cue cards was as follows:
(1) 2 (2) 4 (3) 4 (4) 4 (5) 4 (6) 5 (7) 4 (8) 3 (9) 4 (10) 3 (11) 2

The items were scored with 3 points when the cue card was correctly located on the first trial, with 2 points when correctly located on the second trial, with 1 point when correctly located on the third trial and with zero when more than three trials were needed.

The split-half reliability of the memory test constructed was .478 and showed that the construction of such a test had difficulties with the attention span of mentally retarded subjects at mental age levels of 4-6 years.

The tests used in the hypothesized psychomotor factor were:

- Peg Board. A modification of the Stromberg Dexterity Test without color discriminations
- Bead Stringing. 18 beads of the sort supplied with the S-B test kit.

Both tests measure hand-eye coordination and have showed high loadings on the psychomotor factor in earlier studies with retarded subjects (Meyers et al. 1962, 1964; Kääriäinen 1970a).

The tests used in the hypothesized general verbal factor were:
Van Alstyne Picture Vocabulary Test
Peabody Picture Vocabulary Test

These tests have also shown high loadings in earlier studies (Meyers et al. 1962, 1964; Kääriäinen 1970a) on the general verbal factor. Only the receptive nature of the general verbal factor was studied, because expressive verbal difficulties are common in DS and were not allowed to influence to the results. In the earlier study of the author (Kääriäinen 1970a) the two components of the hypothesized verbal factor, the receptive and the expressive, were not differentiated.

All subjects were tested individually by the author in a quiet room in their wards with the above mentioned test battery.

3.3. Personality traits

Because the compensatory mechanisms postulated in DS could also be explained by possible differences in personality traits, these were taken as an independent measurement area in the research design. The concept of adaptive behavior was used in the studies reviewed to cover also personality traits. They were measured separately in the present study with a special rating scale developed for this purpose according to the findings of Nyholm & Westholm (1971). The results of Nihira (1969a, b) presented in his studies gave support to this decision.

Besides the direct observation of personality traits, the rating technique was the only one possible with mentally retarded as seen from the earlier studies, because the mental age of the DS and control groups was so limited.

The personality trait rating scale was constructed by the author to investigate those personality traits which in the earlier studies were most frequently judged to be present in the comparisons of DS and non-DS groups of severely and moderately mentally retarded individuals in residential and open care. The 50 items constructed were partly selected from the highest loaded items of the factors in the study of Nyholm & Westholm (1971) and partly from items which corresponded to typical findings of stereotype behavior in DS. These items asked about fondness of music and rhythm, tendency to well- or maladjusted behaviors, relations with peers and personnel, play behavior, tendency to help others, emotionality, daily work habits, communication with others, impulsivity and many other personality traits, so that the rater would have had no knowledge of the purpose of the present study.

The items were rated on a 7-point scale from +3 to -3 and the level obtained by a given subject is compared with the whole population of mentally retarded individuals of the same level the rater has seen during the years he or she has worked with the mentally retarded.

The rating scale used is presented in the Appendix. The reliability of the scale was computed as a corrected correlation coefficient between the odd and even items of the scale. It was: $r_{xx} = .894$.

The seven graduated items were explained with a picture illustrating normal distribution and practised before the completion of the scale to guarantee the proper use of it. The author personally interviewed the ward personnel, a total of 22 persons. The criteria for the selection of

the personnel for these interviews were the length of time (in years) in the job, a proper training for the job, and a good knowledge of the subjects studied. On every ward only one person was interviewed. They were mostly the heads of the wards and had all had either nursing-, special nursing-, or special education teacher training and of several years' practical experience in their jobs. The raters were distributed according to their training as follows:

Nurses or special nurses for mentally retarded:	12
Teachers of special education :	6
Heads of day centers :	4
Total :	22

3.4. Social competence

There has been interest in the measurement of the social competence of the retarded since the traditional measure Vineland Social Maturity Scale was first published (Doll 1936). After this scale many other scales designed to measure the social competence of the retarded have come into use. Leland et al. (1967) and Congdon (1969) have reviewed the existing major scales for measuring social competence and reported that the number of available scales is at least ten.

The Cain-Levine Social Competence Scale (Cain, Levine, & Elzey 1963) was developed for the purpose of assessing the social competence of trainable mentally retarded children. It subdivides the general area of social competence into four aspects: Self-Help, Initiative, Social Skills and Communication. The scale contains 44 items and provides an opportunity to compare the results of sub- or total scales with the percentile norms obtained by the standardization with trainable peers. The items in the scale are samples of social competency behaviors which are observable in the daily home or ward situation. Each item provides either four or five descriptive statements which represent varying degrees of independence relative to a specific social competence behavior. The statements are highly operational, permitting the interviewer to focus on specific aspects of the child's behavior and reducing the amount of interpretation and inference required (Cain, Levine, & Elzey 1963).

The scale was developed in several steps in selecting the items and standardized with 716 trainable mentally retarded children ranging in chronological age from 5 to 14 years and in IQ from .25 to .59.

The rater reliability of the Cain-Levine scale with different informants has been .94 (Congdon 1969). This compares with the three-week test-retest correlation of .98 reported in the manual (Cain, Levine, & Elzey 1963).

The criteria for the selection of the Cain-Levine Scale for the present study were:

1) The scale in question has been developed more adequately than many other scales. The selection of items and the standardization procedures in many other scales are not appropriate.
2) The sufficient number of items for a narrower range of retarded. With the other generally used scales (Vineland, PAC etc.) it is difficult to discriminate finer degrees of social competence and compare the results with the results of other retarded children.
3) The factor structure of the Cain-Levine scale has not been studied earlier. For the further use of the scale this kind of examination was needed.

The Cain-Levine scale was completed by the same ward personnel that was interviewed with the personality trait scale. The author assisted in explaining the items. The procedure of questioning in which the interviewer conveyed the intention of the items and selected the appropriate descriptive statement was likely to lead to more accurate ratings than the method in which the respondent was given the scale and asked to select one of the descriptive statements for each item. The purpose of the interview was to determine as objectively as possible the child's actual abilities.

3.5. The reliabilities of the tests and scales used

The realiabilities of the tests and scales used in the present study are presented in the Appendix 21. They were collected from earlier studies based on data from retarded subjects as far as possible. There are also the communalities in factor analyses with retarded subjects according to Meyers et al. 1962 and 1964. In the earlier study of the author (Kääriäinen 1970a) the communalities were SMC communalities in the promax oblique rotation. In the present study they were estimated.

3.6. The sample investigated

The representativeness of the sample is especially difficult to secure when relatively rare conditions such as mentally retarded are used as subjects. If the frequency of the DS in populations of European origin is about 1 in 700 newborns (Penrose & Smith 1966, Benda 1969), the number of newborn DS children in Finland per year can be estimated to be about 70-85. The mortality rate of the syndrome also has its effects on the frequency figures. According to a careful survey (Forsman & Åkesson 1965) in a group of 1263 patients with DS the mortality rate was judged to be 6 per cent higher than for the general population, which was less than 1 per cent. There were no appreciable differences between males and females. In the early years from 1 to 5 the excess mortality was 11 per cent but thereafter until the age of 40 the excess ranged from 3 to 7 per cent in different groups. Above the age of 40 years the rate increased again and after 50 years it exceeded the population standard by 30 per cent.

According to the study by Carter (1958) the survival rates from the data on 725 patients with DS who attended to the Hospital for Sick Children in London between 1944-1955 were as follows; of live born DS cases 30 per cent were dead at 1 month of age, 50 per cent were dead at 1 year of age, and 60 per cent were dead at 10 years of age. Secular changes in mortality have been found after these findings and the earlier figures have slightly decreased with advancing medical care.

It can be concluded from the above figures, that there are difficulties in getting a sample of DS within certain age limits. In the present study the only solution was to collect as many DS cases as possible within a certain chronological and mental age range. The use of the intelligence test battery required that all tests were given to all subjects. So the visually limited, hard of hearing, autistic, aphasic, highly disturbed and most severely retarded were excluded because of their untestability. These symptons are rare in a DS group in which the majority of cases are severely and moderately retarded with an IQ between .25 - .55 (Dey 1971).

The delimitation of subjects by CA and general MA was methodologically desirable, because one was advised to have as few potential sources of extraneous variability as possible. The reduction of CA and MA variability was only possible to a certain degree without loss of subjects. Therefore the male and female DS and their control subjects were allowed to vary between the chronological age of 12 and 20 years and between the mental age of 4 and 7 years.

For every DS subject a control subject was selected from the same ward if possible and matched on sex, chronological age, IQ and mental age. The IQ and mental age were controlled with the help of case records if available and by interviews with the personnel. The subjects were selected so that the ward personnel did not know the purpose of the study. The same limitations for testability as described above were also applied to the control subjects. So in the control group, also called undifferentiated, there were those cases in which a low IQ was accomodated under the normal distribution of a polygenic character and in the DS group cases of mental retardation with chromosomal defect.

The measuring of intelligence was performed first for all subjects. Therefore the requirements of testability were the most important criteria when compared with the other measuring areas, which narrowed the sample.

The sample included all available DS and their control subjects within above mentioned age limits from the area of two Central Institutions for mentally retarded individuals in open and residential care in Central Finland.

In order to get a comparable number of subjects in open care, some subjects were also collected from one day center and from one special school for severely and moderately mentally retarded in Helsinki.

It can be stated in general that in the institutionalized populations male subjects dominate, because females at the same mental level are still able to be in open care and apply for home help. The institutionalized populations are also slightly duller than the retarded populations in open care. Therefore the mixed and combined populations are more likely to be representative when compared with institutional populations, which so often dominate. Therefore the sample of the present study was collected from both forms of care.

Compared with residential care, there are not enough open care services in Finland for mentally retarded. The latter form of care has been developed quite recently only in larger cities and with the help of Central Institutions. In rural areas this type of care has not been available to families with mentally retarded individuals.

All male and female DS cases and their control subjects which fulfilled the criteria described above and which were in open and residential care were investigated in the following institutions, day centers and special schools:

Name of institution	Type of care	Location
Suojarinne	Central institution	Jyväskylä
Ylinen	Central institution	Tampere
Päiväharju	Day center	Jyväskylä
Vaajaharju	Day center	Vaajakoski
Epilä	Day center	Tampere
Kaleva	Day center	Tampere
Vantaala	Day center	Helsinki
Solakallio	Special school	Helsinki

The clinical diagnosis of the DS has usually been made besides the karyotype analysis, with the help of the so-called microsymptoms or physical signs or stigmata of the DS. When the diagnosis is made of the 12 to 20-year-old retarded subjects, the clinical diagnosis of the DS is adequate when made by an experienced observer. In the context of the present study there were no possibilities of getting karyotype analyses of DS subjects. Therefore the ten most characteristic signs selected by Øster (1953) for children and adults and the experience of the author (Kääriäinen & Dingman 1961, Edgren, de la Chapelle, & Kääriäinen 1966) were relied on in the present study for the diagnosis of DS. All subjects in DS group were typical DS cases in which diagnosis was unquestionable, although the diagnoses were not chromosomally confirmed.

Table 1. The mean chronological ages and SDs for the DS and non-DS groups classified according to the type of care and sex

Background variables	DS		non-DS			
	Mean	SD	Mean	SD	t	p
Type of care:						
Open	199.80	44.52	187.92	33.82	2.25	.05
Res.	195.40	50.98	198.11	42.34	0.41	ns
Sex:						
Female	190.39	43.76	203.33	43.79	2.07	.05
Male	207.77	49.60	186.45	33.42	3.80	.001
Total	198.04	46.75	193.02	38.30	1.21	ns

In the total sample there were 104 subjects of which 50 were DS cases and 54 non-DS cases. 55 were male and 49 female subjects. There

were 57 cases in open care and 47 in residential care. The mean chronological age in months for the total sample was 195.43 and SD = 42.43.

It can be stated from the t-values of the mean differences of the chronological age variable in Table 1 that there was a significant difference between the male DS and non-DS subjects.

3.7. Statistical methods used

The normality of the original variables was tested with the ÅMEKE program (The Computing Center, University of Jyväskylä), which computes the means, standard deviations, medians, standard errors of medians, upper and lower quartiles, degree of kurtosis, measures of skewness and z-values (D'Agostino 1970).

The subgroups were too small for transformation analyses, therefore factor analyses with the total sample were used. The correlation matrices of physical growth, intelligence, personality traits and social competence were first analysed by means of the principal component analyses to get the eigenvalues, which were used among the criteria for the correct number of common factors.

The combined criterion of the number of common factors consisted of:

1. Eigenvalues greater than one
2. The cumulative percentages of the factors from the total variance
3. The interpretability of the factors
4. The scree-test of Cattell (1966)

The techniques mentioned in the investigations of Horn (1965), of Humphreys and Ilgen (1969) and of Kaiser (1970) were not used in this study.

After deciding the number of factors in the different matrices used, the factor analyses with the estimated communalities were made by using the varimax orthogonal rotations. The varimax rotation was selected because further analyses with the factor scores assume uncorrelated factors. If the factor scores are used as predictors and if they are correlated, it is difficult to interpret their relationships to the dependent variable. On the orthogonal variables independent tests of significance are possible and the situation is greatly simplified (Gorsuch 1973). The oblique promax rotations were also computed as a control for the orthogonal solutions.

The factor scores were computed with the regression method, which yields appropriate factor score estimates for evaluating group differences on factors (Tucker 1971). The principal component scores were also computed for all factors. The interpretation of the principal components was not successful and component scores were not used in the present study. Their discrimination power, however, was slightly more effective than that of the factor scores. This observation concerned the physical growth component scores compared with physical growth factor scores. The use of factor scores allowed, however, for a relative fine differentation between individuals for predictive purposes.

The linearity of regressions of the factor scores was tested with the ÅREGT program (The Computing Center, University of Jyväskylä). If the F's for the control of linearity falled beyond the .01 probability level, the hypothesis of linear regression for the population being sampled was rejected (McNemar 1955, p. 272).

The discriminant analyses were computed with the HYLPS program (The Computing Center of the University of Helsinki) comprising the following subprograms: ID, IT, MG, CG, DP, DF, DC, and IL. All of the information yielded by the program is not reported in the appendices of the present study. The special condition for the use of the discriminant analysis, the F-test for the equality of the covariance matrices, was computed in the program according to the F-approximation developed by Box. The other conditions for the use of discriminant analysis, normal distributions and interval scales, can be assumed ex definitionem.

Because the sample was not representative, sampling error adjustments were used to correct the accuracy of comparisons. However, they by no means compensated for the biases of the sampling procedures, which were especially difficult to avoid when relatively rare-conditions of mental retardation were investigated. The analysis of covariance (BMD 04V program) was used to increase the accuracy and efficiency of comparisons in the experimental data. The BMD 04V program is designed to compute analysis-of-variance information for one analysis of variance variable with multiple covariates and unequal treatment group sizes. It is a method for making allowance for uncontrolled variables and to set forth the sampling error adjustment, which is needed in testing the statistical significance of the difference between the corrected means of two or more subgroups. The method is applicable whenever it seems desirable to correct a difference on a dependent variable for known differences on

other variables, which for some reasons could not be controlled by matching or by random sampling procedures. The problem is to specify what effect the noncomparability of the groups with respect to uncontrolled variables has on the means of the dependent variable. The covariance adjustment method will not necessarily reduce the differences between the means on the dependent variable. With groups differing on uncontrolled variables, it is not as proper, but equally necessary to use the covariance technique when the groups are nearly the same on the dependent variable as when they are different (McNemar p. 343-356).

The BMD 04V program was run separately for all factors of the different matrices added with the chronological age variable. So all factors and the chronological age variable were used separately as a dependent variable and all other factors in the same matrix as independent variables. The program was also used so that all other 22 factors were used as independent variables when one at a time was a dependent variable.

The canonical correlation analysis factors two matrices simultaneously, in order to extract factors which are uncorrelated within their matrices but which provide maximum correlations of pairs of factors across matrices. The first factor of each matrix is located so that the canonical correlation of the first factors is maximized. The resulting coefficient is the largest product-moment correlation that can be developed between linear functions of the two matrices (Cooley & Lohnes 1971 p. 12). If the variables on the same side are uncorrelated, the coefficients of correlations between the original variables and the canonical variable can be compared and the interpretation of the canonical variable is easy to make, because the coefficients express the extent to which the canonical factor is varying in the same direction as the original variables (Lange p. 4).

The redundance analyses, which express the amount of actual overlap between the matrices that is packaged in the canonical relationship, were not computed with the program used. Therefore these analyses were made by the author using a desk calculator as follows (Cooley & Lohnes 1971 p. 170):

$$R_{dx} = \frac{s_1' s_1}{p_1} \cdot R_c^2$$

$$R_{dy} = \frac{s_2' s_2}{p_2} \cdot R_c^2$$

where the proportion of the variance extracted from the first matrix by

the canonical factor x is $(s'_1 s_1)/p_1$ and the proportion of the variance extracted from the second matrix by the canonical factor y is $(s'_2 s_2)/p_2$. The redundance analyses were made for the significant canonical correlations only.

The redundance measure is important, because a very large canonical correlation coefficient could be the result of a very large zero-order correlation of just one variable of one set with just one variable of the other set and the remainder of the two sets could be essentially uninvolved in the canonical structure (Cooley & Lohnes 1971 p. 176). It is an invaluable aid for placing the R_c in proper perspective (Wood 1972).

For measurements in human genetics it is possible to compute a special value for the discrimination power developed by Penrose (1951):

$$\frac{D}{\bar{s}} = \frac{M_1 - M_2}{1/2(S_1+S_2)}$$

M = mean of discriminant scores

S = SD of discriminant scores

If there is a marked disparity between the variances of the two groups studied, the usual estimation of a common variance, as done for the t-test of a difference, is not valid. The mean standard deviation of the two groups compared, $\bar{s} = 1/2\ (S_1 + S_2)$, makes it possible, on the assumption that both groups have Gaussian distributions, to discover what proportion of individuals are misclassified at the point where equal quantities of each group are assigned to the wrong genotypes. The position of the critical line is independent of the sizes of the two populations. It is found with the formula:

$$C = \frac{(M_1 S_2 + M_2 S_1)}{(S_1 + S_2)}$$

The distinctions useful in the study of human genetics are those in which the index $D/\bar{s}$ amounts to more than 3. When the values fall below 2, the effects are not large enough to give any indications of bimodality in the total distributions (Penrose 1951). The index of Penrose was computed for all discriminant analyses used.

The statistical analyses of the present study were carried out at the Computing Center of the University of Jyväskylä. The numbers and names of the variables used are in Appendix 1.

4. RESULTS

4.1. The tests of normality of the variables used

Appendix 2 shows the means, standard deviations, measures of skewness, degree of kurtosis and z-values (D'Agostino 1970) of variables 5-34 and the same information without z-values for variables 35-128. Only the distribution of variable no 21, the waist girth, had not normal values of the z, of the kurtosis, and of the skewness as seen in Appendix 2.

4.2. The factor analyses and the scores of the matrices measured

4.2.1. Physical growth

The correlation matrix of variables 5-24 is not reported. The principal component analysis was made to obtain the eigenvalues of the matrix. They are presented in Appendix 3. The factor number was concluded to be five. The factor analysis was performed with the communality estimates and with varimax rotation. The varimax solution is shown in Table 2. The promax oblique rotation is not reported.

Table 2. The varimax solution of the physical growth variables; 5 factors

Variables	Factors					h^2
	301	302	303	304	305	
5. Max. head length	.85	-.02	-.03	.30	.11	.83
6. Max. head breadth	.64	.22	.07	.12	.26	.55
7. Max. circumf. of head	.90	.14	.01	.26	.18	.94
8. Cephalic index	-.04	.06	-.99	-.04	-.01	.99
9. Bizygomatic breadth	.46	.43	.04	.29	.50	.74
10. Bigonial breadth	.43	.40	.01	.30	.54	.74
11. Morphol.facial height	.50	.05	.08	.61	.20	.68
12. Facial index	-.01	.04	-.99	-.01	-.02	.99
13. Standing height	.33	.26	.05	.83	.27	.96
14. Weight	.22	.84	-.04	.42	.08	.95
15. Index	-.16	-.93	.00	-.21	-.00	.94
16. Sitting height	.28	.35	.02	.86	-.04	.94

continued

Table 2 (continued)

Variables	Factors 301	302	303	303	305	h^2
17. Skelic index	-.01	.04	-.99	-.02	-.00	1.00
18. Span	.36	.18	.01	.77	.45	.97
19. Index	.31	-.13	.00	.14	.67	.58
20. Axil.chest girth	.26	.86	-.01	.21	.00	.86
21. Minim.circtrunk-waist	-.05	.70	.00	-.01	.19	.54
22. Max.circ.right thigh	.02	.94	-.07	.07	-.11	.91
23. Max.circ.r.forearm	.10	.82	-.11	.36	.05	.83
24. Index	.02	.69	-.04	-.47	.03	.71
Contribution of factor	3.19	5.55	3.02	3.43	1.50	16.71
% of common variance	19.1	33.2	18.0	20.5	9.0	

The five physical growth factors had the highest factor loadings on the following variables which describe the names and nature of the factors:

Factor 301:

Var.no 7 Head: max.circumference .90
" 5 " : max.length .85
" 6 " : max.breadth .64
" 11 Face: morph.facial height .50
" 9 " : bizygomatic breadth .56
" 10 " : bigonial breadth .43

301 was a factor of head

Factor 302:

Var.no 22 Max.circumference of the right thigh .94
" 15 Body: index .93
" 20 Axillary chest girth .86
" 14 Weight .84
" 23 Max.circumf.of the right forearm .82
" 21 Min.circumf.of the trunk-w.girth .70
" 24 Index .69

302 was a factor of stockiness

Factor 303:

Var.no 12 Facial index .99
" 17 Body index .99
" 8 Head index .99

303 was a index factor

Factor 304:

Var.no 16	Sitting height	.86
" 13	Body height	.83
" 18	Span	.77
" 11	Facial height	.61
" 24	Index	-.47

304 was a factor of vertical height

Factor 305:

Var.no 19	Body index	.67
" 10	Facial breadth (upper)	.54
" 9	Facial breadth (lower)	.50
" 18	Span	.45

305 was a factor of horizontal breadth

4.2.2. Intelligence

The correlation matrix of variables 25-34 is not reported. The eigenvalues of the principal component analysis are shown in Appendix 3. The factor analysis was made with four factors and with communality estimates and with the varimax rotation. The varimax solution is presented in Table 3. The promax oblique rotation is not reported.

Table 3. The varimax solution of the intelligence variables; 4 factors

	Factors				
Variables	311	312	313	314	h^2
25. Peg Board	.30	.68	.24	.00	.62
26. Bead Stringing	.06	.77	.14	.01	.61
27. Raven	.41	.15	.48	.29	.52
28. Short-term memory	.62	-.02	.04	.52	.27
29. Van Alstyne	.27	.15	.84	.09	.82
30. Peabody Pict.Voc.Test	.30	.28	.80	.08	.82
31. Block Design	.73	.23	.29	.25	.74
32. Auditory-Voc.Seq.Test	.39	.22	.41	-.00	.37
33. Identical Pictures	.58	.18	.30	.39	.63
34. Pacific Pattern Cop.	.79	.10	.27	-.02	.71
Contribution of factor	2.11	1.34	2.11	.59	6.16
% of common variance	34.3	21.7	34.2	9.7	

The four intelligence factors had the highest factor loadings on the following variables which describe the names and nature of the factors:

Factor 311:

Var.no 34	Pacific Pattern Copying	.79
"	31 Block Design	.73
"	33 Identical Pictures	.58
"	27 Raven	.41

311 was a factor of visual perception

Factor 312:

Var.no 26	Bead stringing	.77
"	25 Peg Board	.68

312 was a psychomotor factor

Factor 313:

Var.no 29	Van Alstyne	.84
"	30 Peabody Picture Vocabulary Test	.80
"	27 Raven	.48
"	32 Auditory-Vocal Sequencing Test	.41

313 was a verbal factor

Factor 314:

Var.no 28	Short-term memory test	.52
"	33 Identical Pictures	.39

314 was a short-term memory factor

4.2.3. Personality traits

The correlation matrix of personality trait variables is not reported. The eigenvalues of the principal component analysis are presented in Appendix 3. The factor analysis was made with eight factors and with communality estimates and with varimax rotation. The varimax solution is shown in Table 4. The promax oblique rotation is not reported.

Table 4. The varimax solution of the personality trait variables. 8 factors

Variables	321	322	323	324	325	326	327	328	h^2
35. Cheerful, glad	.54	.09	.05	.00	-.04	.07	.48	.02	.54
36. Social	.24	.36	.28	.10	.03	.03	.63	.07	.68
37. Docile	.71	-.13	-.15	.26	-.32	.06	-.06	.12	.76
38. Not angry	.83	-.06	-.22	.15	.06	.15	-.10	.02	.80
39. Not violence	.48	-.16	.01	.15	-.03	.75	-.01	-.06	.86
40. Nondestructive	.38	-.42	.01	.40	.10	.37	-.04	-.11	.65
41. Good to everybody	.37	-.15	.02	.15	-.04	.81	-.04	-.00	.86
42. Even-tempered	.75	-.20	-.07	.37	.18	.06	-.21	-.03	.84
43. Loud, noisy	-.33	.24	.10	-.11	-.00	-.04	.80	.03	.85
44. Talkative	-.33	.18	.12	-.10	-.04	.02	.82	-.01	.85
45. Careful	.28	-.08	.06	.74	-.01	.05	.04	.03	.65
46. Brave	-.12	.77	.05	-.06	-.06	-.13	.33	.00	.75
47. Fast	-.25	.59	.20	.01	-.33	-.07	.06	-.12	.59
48. Self-confident	-.23	.72	.00	-.08	.08	-.07	.47	.01	.82
49. Can concentrate	.23	.04	-.03	.79	.09	.01	-.00	-.19	.73
50. Independent	-.05	.63	.10	.19	.03	.05	-.01	.05	.46
51. Kind	.58	.04	.22	.07	-.22	.23	.30	.12	.61
52. Peaceful	.71	-.08	-.01	.19	-.12	.38	-.04	.16	.74
53. Spontaneous	-.10	.29	.11	.10	.15	.03	.79	.01	.78
54. Adjusts well	.57	.03	.04	.36	.00	.13	.13	.15	.53
55. Interested a. people	.05	.09	.21	.24	-.00	-.06	.39	-.35	.41
56. Even, patient	.85	-.15	-.08	.18	.10	.05	-.06	-.10	.82
57. Industrious	.28	.20	-.00	.61	-.19	-.04	.15	.17	.59
58. Bold, brave	-.14	.84	.03	.01	.03	-.17	.24	-.03	.82
59. Changes of mood	.74	-.20	-.21	.28	.12	.02	-.14	-.08	.76
60. Tough, persistent	.21	.10	-.20	.76	.14	.12	-.00	-.07	.71
61. Sexual activity	-.10	.10	.43	-.03	.29	-.04	.23	-.00	.35
62. Fond of nurses, peers	.00	.11	.56	.01	.12	.17	.22	.11	.43
63. Fond of music	.03	-.00	.18	.05	.44	-.00	.35	-.01	.35
64. Tendency to imitate	-.15	.18	.21	-.15	.32	-.22	.37	-.15	.44
65. Does not quarrel	.72	-.22	-.13	.11	.07	.33	-.22	-.02	.77
66. Is satisfied	.51	-.05	-.41	.03	.04	.03	-.01	-.12	.45
67. Easy to get along	.72	-.00	-.13	.35	.01	.17	.04	.22	.75
68. Not mind criticism	.35	.05	-.63	.00	.09	-.05	-.02	.21	.59

continued

Table 4. (continued)

Variables	321	322	323	324	325	326	327	328	h^2
69. Not contradict nurses	.61	-.16	-.28	.15	-.38	.11	-.18	-.12	.71
70. Not noisy when bad-t.	.60	-.25	-.19	.13	-.03	.21	-.18	-.30	.66
71. Not rude to nurses	.71	-.26	-.16	.14	-.22	.19	-.19	-.01	.75
72. Talks willingly	-.05	.20	.25	-.00	.09	-.06	.73	.02	.65
73. Self-sufficient	-.25	.72	-.00	.02	.12	-.11	.38	-.04	.77
74. Initiative in play	.10	.52	.06	.06	.14	-.12	.53	.03	.61
75. Boastful	-.42	.48	-.05	-.22	.22	-.09	.36	.13	.68
76. Vigorous games	.02	.46	-.05	-.12	.06	-.28	.33	.31	.52
77. Behave acc. instr.	.27	.01	.11	.79	-.12	.07	.00	.08	.75
78. Willing to fin. tasks	.08	-.10	.06	.80	-.03	.25	-.14	-.05	.75
79. Helpful if needed	.17	.13	.43	.41	-.20	.00	.15	.30	.57
80. Gets on eas. w. peers	.66	.00	.04	.24	-.03	.43	.01	.10	.70
81. Interested a. new task	.16	.34	.07	.22	-.11	.04	.36	.30	.44
82. Strives f. popularity	-.11	.34	.50	-.00	.07	-.13	.20	-.03	.45
83. Kind to juniors	.34	-.16	.08	.09	-.00	.65	-.01	.04	.60
84. Does not mind if dis.	.31	.05	-.65	-.05	-.05	-.04	-.19	.04	.58
Contribution of factor	9.60	5.21	2.78	4.91	1.28	2.89	5.38	.94	33.02
% of common variance	29.1	15.8	8.4	14.9	3.9	8.8	16.3	2.8	

The eight personality trait factors had the highest loadings on the following variables, which describe the names and nature of the factors:

Factor 321:

Var.no 56	Even, good-natured, patient	.85
" 38	Does not become angry, irritated	.83
" 42	Even-tempered, placid	.75
" 59	Slight changes of mood	.74
" 67	It is easy to get along with him	.72
" 65	Does not quarrel easily with peers	.72
" 37	Docile, obedient	.71
" 52	Peaceful	.71
" 71	Is not rude to the nurses	.71

321 was a factor of evenness, good-naturedness

Factor 322:

Var.no 58	Bold, brave	.84
" 46	Brave	.77
" 73	Self-confident, self-sufficient	.72
" 48	Self-confident	.72
" 50	Independent, original	.63
" 47	Fast	.59

322 was a factor of boldness, braveness and self-confidence

Factor 323:

Var.no 84	Is sorry, if discriminated	.65
" 68	Is offended by criticism	.63
" 62	Fondness of nurses and peers	.56
" 61	Shows sexual activity	.43

323 was a factor of emotionalism

Factor 324:

Var.no 78	Is willing to finish with tasks	.80
" 77	Can be trusted to behave according to instructions	.79
" 49	Can concentrate	.79
" 60	Tough, persistent	.76
" 45	Careful	.74
" 57	Industrious, enterprising	.61

324 was a factor of concentration, carefulness

Factor 325:

Var.no 63	Fond of music and rhythm	.44
" 69	Contradicts nurses	.38
" 47	Slow	.33
" 37	Disobedient, tricky, independent	.32

325 was a factor of fondness of music and rhythm, independence

Factor 326:

Var.no 41	Good to everybody	.81
" 39	Does not use violence against anybody	.75
" 83	Is kind to one's junior, does not bully them	.65
" 80	Gets on easily with peers	.43

326 was a factor of goodness to everybody

Factor 327:

Var.no 44	Talkative	.82
" 43	Loud, noisy	.80
" 53	Spontaneous	.79
" 72	Talks willingly with others	.73
" 36	Social, companionable	.63
" 74	Initiative in play	.53
" 48	Self-confident	.47

327 was a factor of talkativeness and spontaneity

Factor 328:

Var.no 55	More interested in things	.35
" 76	Participates willingly in vigorous games	.31
" 70	Noisy when bad-tempered	.30
" 79	Helpful, if needed	.30

328 was a factor of openness and impulsiveness

4.2.4. Social competence

The correlation matrix of variables 85-128 is not reported. The eigenvalues of the principal component analysis are shown in Appendix 3. The factor analysis was made with six factors and with the varimax rotation. The varimax solution is presented in Table 5. The promax oblique rotation is not reported.

Table 5. The varimax solution of the social competence variables. 6 factors

Variables	331	332	333	334	335	336	h^2
85. Dressing	.63	.10	.09	.03	.13	.29	.53
86. Tying shoe laces	.58	.29	.08	-.03	.12	.35	.57
87. Initiating dressing	.81	.00	.02	.15	.08	.06	.69
88. Undressing	.85	.03	.04	.16	-.05	.06	.77
89. Care of shoes	.39	.16	.07	.04	.19	.54	.52
90. Washing hand, face	.59	.04	.14	-.24	.15	.45	.67
91. Brushing teeth	.63	.03	-.02	-.35	.31	.37	.76
92. Keeping nose clean	.66	.25	.09	-.18	.18	.39	.72
93. Toileting	.82	.08	.15	.03	-.01	.08	.71

continued

Table 5 (continued)

Variance	331	332	333	334	335	336	h^2
94. Use of utensils	.66	.24	.10	.27	-.02	.12	.59
95. Use of knife	.60	.24	.07	.21	.05	.30	.57
96. Food preparation	.23	.15	.07	.29	.03	.48	.41
97. Table setting	.46	.15	.22	.43	.05	.23	.53
98. Clearing table	.56	.02	.20	.24	.02	.35	.54
99. Cleaning up liquids	.43	.16	.18	.06	.28	.64	.74
100. Cleaning up mess	.27	.07	.21	.07	.14	.75	.71
101. Reporting accidents	.07	.30	-.04	.08	.53	.44	.59
102. Completing tasks	.18	.07	.45	.02	.09	.54	.55
103. Attending to tasks	.26	.07	.44	.04	-.08	.45	.48
104. Making bed	.46	.01	.07	.26	.26	.49	.60
105. Sweeping	.35	.14	.18	.27	.10	.53	.55
106. Folding articles	.26	.15	-.08	.08	.23	.60	.53
107. Putting toys away	.05	.10	.32	.01	.22	.69	.65
108. Hanging up clothes	.45	.12	.27	-.22	.21	.47	.61
109. Going on errands	.16	.29	.04	.59	.26	.20	.58
110. Freedom of movements	.32	.23	.08	.40	.29	.06	.42
111. Answering telephone	.20	.43	.02	.32	.32	.10	.45
112. Sharing	.01	.10	.56	.02	.41	.23	.55
113. Borrowing	.22	.05	.65	.07	.33	.19	.64
114. Returning property	.25	.03	.65	.07	.29	.23	.64
115. Playing with others	.08	.01	.22	.07	.76	.05	.65
116. Initiating play	.08	.07	.14	.09	.69	.15	.54
117. Offering assist.	.10	-.00	.29	.06	.60	.45	.67
118. Helping others	.04	.06	.27	.04	.61	.48	.69
119. Use of language	.03	.84	.04	-.01	.11	.02	.72
120. Clar. of speech	.15	.79	.10	-.15	-.11	.00	.70
121. Underst. speech	.30	.69	.12	-.07	-.22	-.07	.65
122. Idenfication	.13	.67	.17	.17	.03	.11	.54
123. Repeating words	.07	.77	.09	.14	-.12	.07	.65
124. Indicating wants	.14	.79	.00	.04	.04	.13	.67
125. Answering quest.	-.04	.80	-.07	.06	.15	.14	.70
126. Answering door	-.00	.68	-.17	.09	.34	.13	.64
127. Deliver.messages	.09	.67	.06	.21	.21	.18	.58
128. Rel.obj. to act.	.13	.43	-.07	.27	.29	.27	.45
Contrib. of factor	7.05	6.19	2.44	1.82	3.70	5.70	26.92
% of com. variance	26.2	23.0	9.0	6.8	13.75	21.1	

The six social competence factors had the highest factor loadings on the following variables, which describe the names and nature of the factors:

Factor 331:

Var.no 88	Undressing	.85
" 93	Toileting	.82
" 87	Initiating dressing	.81
" 92	Keeping nose clean	.66
" 94	Use of utensils	.66
" 85	Dressing	.63
" 91	Brushing teeth	.63

331 was a factor of self-help

Factor 332:

Var.no 119	Use of language	.84
" 125	Answering questions	.80
" 124	Indicating wants	.79
" 120	Clarity of speech	.79
" 123	Repeating words	.77
" 121	Understandable speech	.69
" 126	Answering door	.68

332 was a factor of communication

Factor 333:

Var.no 113	Borrowing	.65
" 114	Returning property	.65
" 112	Sharing	.56
" 102	Completing tasks	.45

333 was a factor of reliability and responsibility

Factor 334:

Var.no 109	Going on errands	.59
" 97	Table setting	.43
" 110	Freedom of movement	.40
" 91	Brushing teeth	.35
" 111	Answering telephone	.32

334 was a factor of errand-willingness

Factor 335:

Var.no 115	Playing with others	.76
" 116	Initiating play	.69
" 118	Helping others	.61
" 117	Offering assistance	.60

335 was a factor of play and assistance

Factor 336:

Var.no 100	Cleaning up mess	.75
" 107	Putting toys away	.69
" 99	Cleaning up liquids	.64
" 106	Folding articles	.60

336 was a factor of cleanness

4.2.5. The linearity of the regressions of the factor scores

All the 506 regressions of the 23 factors were tested for linearity of regressions. Only three (0.59%) of these regressions fell beyond the .001 probability level and nine (1.78 %) beyond the .01 level and indicated that the hypothesis of linear regression was rejected. The tests of the linearity of the regressions are not reported in the context of the present study.

4.2.6. The correlations of the factors with chronological age

The factor score correlations with chronological age in the total sample and in DS and non-DS groups are presented in Appendix 4. Of the correlations only four were over .30. They were:

Factor 302 stockiness/chronological age	.53
Factor 336 cleanness /chronological age	.48
Factor 326 goodness to everybody/chronological age	.34
Factor 304 vertical height/chronological age	.31

4.3. The discriminant analyses between the Down's syndrome and non-Down's syndrome groups

4.3.1. Physical growth

The discriminant analyses with the five factor scores of physical growth and with DS and non-DS groups are found in abridged form in Appendix 5. The variables in the model are ordered according to the discrimination power of the variables in this combination. The parameter RISKP in the program of HYLPS was 0.0 and 50.0 per cent. It is a minimum value for the probability of the additional information of the variables left over from the model. With the RISKP = 50.0 the model left over the index factor 303, which did not give additional information for the discrimination function and the difference between the models with the four and with the five factors was not significant according to the program. Factors 305 (horizontal breadth) and 301 (head) had the highest discrimination powers of the physical growth factors.

4.3.2. Intelligence

The discriminant analyses with the four intelligence factors and with DS and non-DS groups are presented in abridged form in Appendix 6. With the RISKP = 50.0 the model left over the short-term memory factor 314. The most discriminating were psychomotor, verbal and visual perception factors.

4.3.3. Personality traits

The discriminant analyses with the eight personality trait factors and with DS and non-DS groups are found in abridged form in Appendix 7. With the RISKP = 50.0 factors 321 (evenness, good-naturedness), 327 (talkativeness, spontaneousness), 322 (boldness, braveness, self-confidence), and 326 (goodness to everybody) were left over from the model since they did not give additional information for the discrimination. As a group the personality trait factors discriminated the groups studied only slightly more weakly than the factors of intelligence, as seen in Table 6. In the discriminant analysis with the eight personality trait factors and with the RISKP = 50.0 only the following four factors were included in the model:

325 fondness of music
328 openness and impulsiveness
324 carefulness, concentration
323 emotionalism

4.3.4. Social competence

The discriminant analyses with the six social competence factors and with DS and non-DS groups are shown in abridged form in Appendix 8. With the RISKP = 50.0 factors 336 (cleanness), 335 (play and assistance), 333 (reliability and responsibility), and 334 (errand-willingness) were left over from the model since they did not give additional information to the discrimination of the two factors: 332 (communication) and 331 (self-help). As a single measurement area the social competence factors discriminated the DS and non-DS groups at a markedly lower level than the other measurement areas, as seen in Table 6.

4.3.5. The discriminant analyses with all 23 factors of the matrices

The discriminant analyses with all 23 factors are presented in abridged form in Appendix 9. With the RISKP = 50.0 only the following 10 factors in the model were arranged according to discrimination power:

1. 325 fondness of music and rhythm, independece
2. 312 psychomotor
3. 305 horizontal breadth
4. 301 head
5. 304 vertical height
6. 302 stockiness
7. 328 openness and impulsiveness
8. 332 communication
9. 311 visual perception
10. 314 short-term memory

According to the program the difference between the discrimination powers of the models with the 10 obtained and with all 23 factor variables was not significant.

In the model with the RISKP = 50.0 there were 4 factors from the physical growth matrix, 3 factors from the intelligence matrix, 2 factors from the personality trait matrix, and 1 factor from the social competence

matrix. The discrimination scores of the optimal 10 factor model are presented in graphed form in Figure 2.

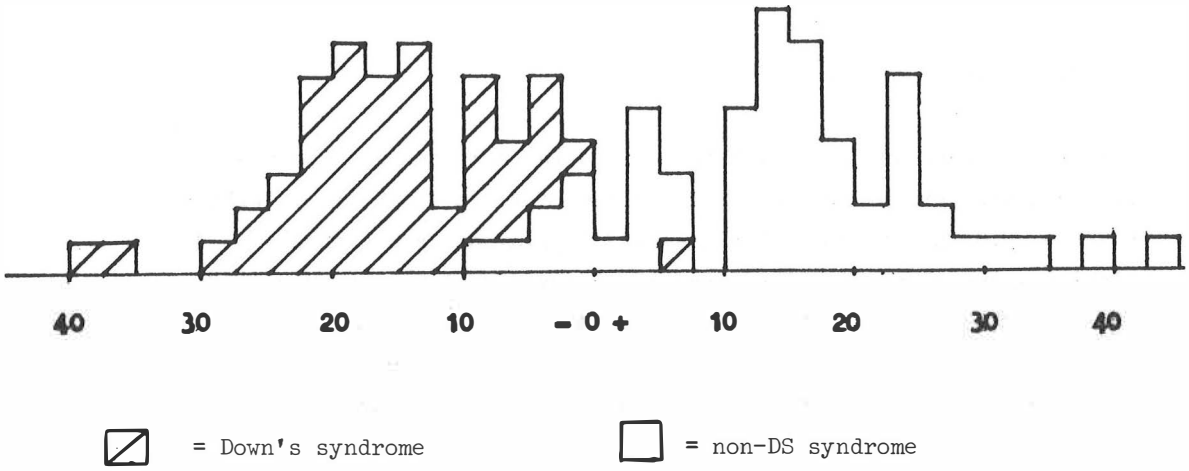


Figure 2. The discrimination scores of the optimal 10 factor solution

Table 6 gives the discrimination powers of the different matrices measured with F-values and with RISKP = 50.0 and 0.0.

Table 6. The discrimination powers of the matrices between the DS and non-DS groups and measured with the F-approximation of Wilks Lambda with RISKP = 0.0 and 50.0

Matrix	With RISKP = 0.0			With RISKP = 50.0		
	F		p <	F		p <
Physical growth	(5,98)	22.41	.001	(4,99)	27.95	.001
Intelligence	(4,99)	10.87	.001	(3,100)	13.58	.001
Personality traits	(8,95)	6.16	.001	(4,99)	12.33	.001
Social competence	(6,97)	1.77	.112	(2,101)	5.32	.006
All 23 factors	(23,80)	8.43	.001			
10 optimal factors				(10,93)	21.23	.001

4.4. The canonical correlation analyses between the matrices measured

The canonical correlation analyses were computed between the matrices of physical growth and intelligence and between personality trait and physical

growth matrices with DS and non-DS groups separately and with all subjects. Only significant canonical correlations with the redundance analyses are reported here. They are found in Appendices 10 and 11 respectively. The canonical correlation analysis between the matrices of intelligence on the other side and personality traits and social competence on another side were also computed with both subgroups separately and with all subjects. They are shown in Appendix 12.

In the canonical correlation analysis with all subjects and between the factors of physical growth and intelligence only the first canonical correlation was significant ($p < .01$), as seen in Appendix 10. The redundance analysis revealed that 5 per cent of the variance of physical growth was explained by the first canonical factor of intelligence and 6 per cent of the variance of intelligence was explained by the first canonical factor of physical growth.

In the canonical correlation analysis with all subjects and between the factors of physical growth and the factors of the personality traits only the first canonical correlation was significant ($p < .001$), as seen in Appendix 11. The redundace analysis showed that only 4 per cent of the variance of the personality traits was explained by the first canonical factor of physical growth and only 6 per cent of the variance of physical growth was explained by the first canonical factor of the personality traits.

In the canonical correlation analysis with DS and non-DS groups separately and between the physical growth and intelligence factors the first canonical correlation was only significant ($p < .10$) for non-DS group, and of the variance of physical growth 6 per cent was explained by the first canonical factor of intelligence. Of the variance of intelligence 9 per cent was explained by the first canonical factor of physical growth.

In the canonical correlation analysis with the DS and non-DS groups separately and between the physical growth and personality trait factors the first canonical correlations were significant in both groups. Of the variance of personality traits 3 per cent in the non-DS group and 6 per cent in the DS group was explained by the first canonical factor of physical growth. Of the variance of physical growth 7 per cent in the non-DS group and 8 per cent in the DS group was explained by the first canonical factor of personality traits.

In the canonical correlation analysis between the intelligence factors on the other side and the personality trait and social competence

factors on another side and with all subjects there were two significant canonical correlations as seen in Appendix 12.

Of the variance of personality traits and of social competence 5 per cent was explained by the first canonical factor of intelligence. 17 per cent of the variance of intelligence was explained by the first canonical factor of personality traits and of social competence. The corresponding figures for the second canonical factor were 2 per cent and 6 per cent respectively.

The redundances in the canonical correlation analyses between the intelligence factors on the other side and the personality traits and social competence factors on another side, made separately for the DS and non-DS groups, were:

	Redundance	
	non-DS	DS
Canonical correlation 1	$p < .001$	$p < .001$
1 personality traits, social competence	6.8 %	4.8 %
2 intelligence	21.7 %	15.2 %
Canonical correlation 2	$p < .02$	$p < .05$
1 personality traits, social competence	3.4 %	2.5 %
2 intelligence	10.2 %	10.6 %

There were no marked differences between the redundances in DS and non-DS groups.

The redundance analyses indicated that there were only slight overlaps between the matrices studied.

4.5. The covariance analyses of the matrices measured

4.5.1. Physical growth

From the covariance analyses with the five physical growth factors added to chronological age only the group means, adjusted means, and F-values of the null hypothesis are reported, which verifies that there is no difference among groups after adjusting with covariates. They are presented in Appendix 13.

The factor mean profiles of the physical growth factors with the adjusted means and significance levels for both subgroups are illustrated in Figure 3.

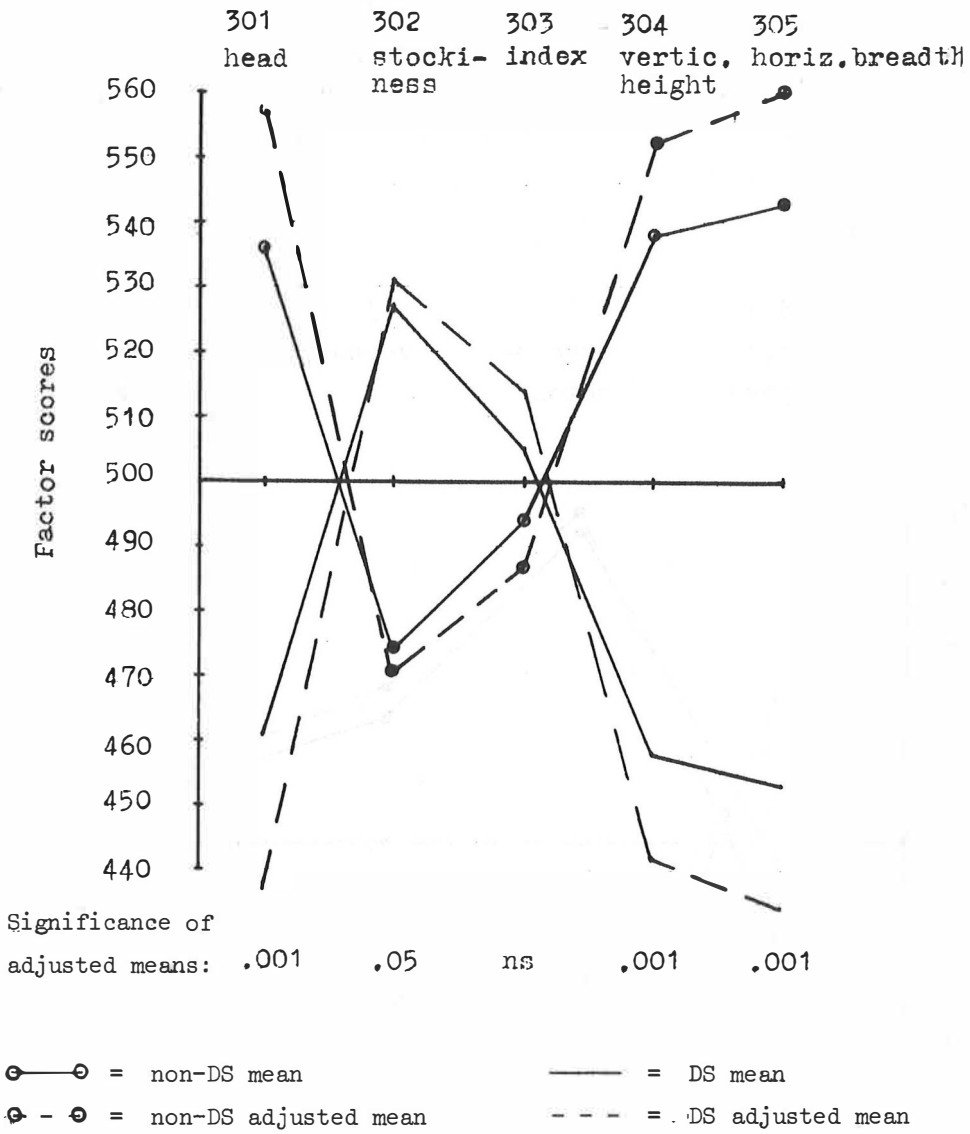


Figure 3. The factor mean profiles of the physical growth factors with the adjusted means and significance levels for both subgroups

After adjusting with covariates in physical growth area factors 301 (head), 304 (vertical height), and 305 (horizontal breadth) had highly significant differences between the groups studied.

4.5.2. Intelligence

The covariance analyses with the four intelligence factors and chronological age are presented in abridged form in Appendix 14. The factor mean profiles of the intelligence factors in both subgroups and with adjusted means and significance levels are in Figure 4. In the intelligence area only psychomotor factor 312 had highly significant difference between the groups studied.

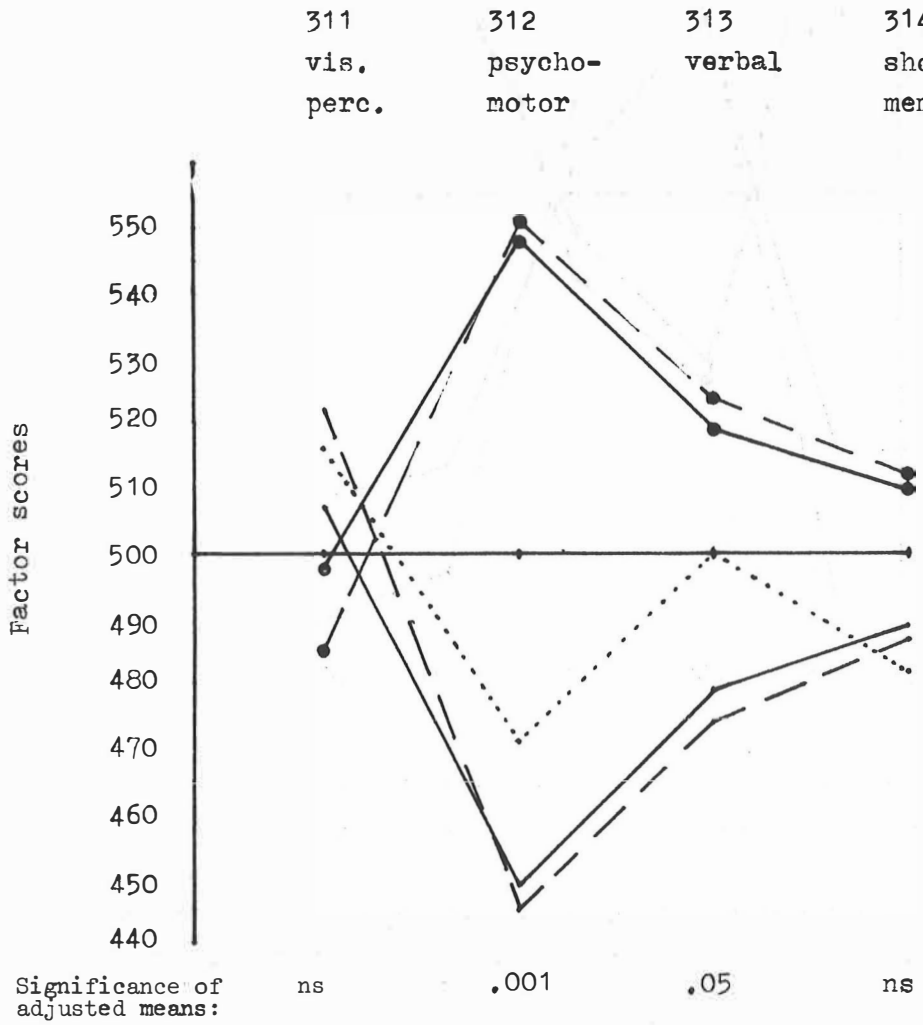


Figure 4. The factor mean profiles of the intelligence factors with the adjusted means and significance levels for both subgroups

4.5.3. Personality traits

The covariance analyses with the eight personality trait factors and chronological age are shown in abridged form in Appendix 15. The factor mean profiles of the personality trait factors for both subgroups are illustrated in Figure 5. After adjusting with covariates in personality trait area only factors 325 (fondness of music) and 328 (openness) had significant differences between the groups studied. The levels of significance were $p < .001$ and $p < .01$ respectively.

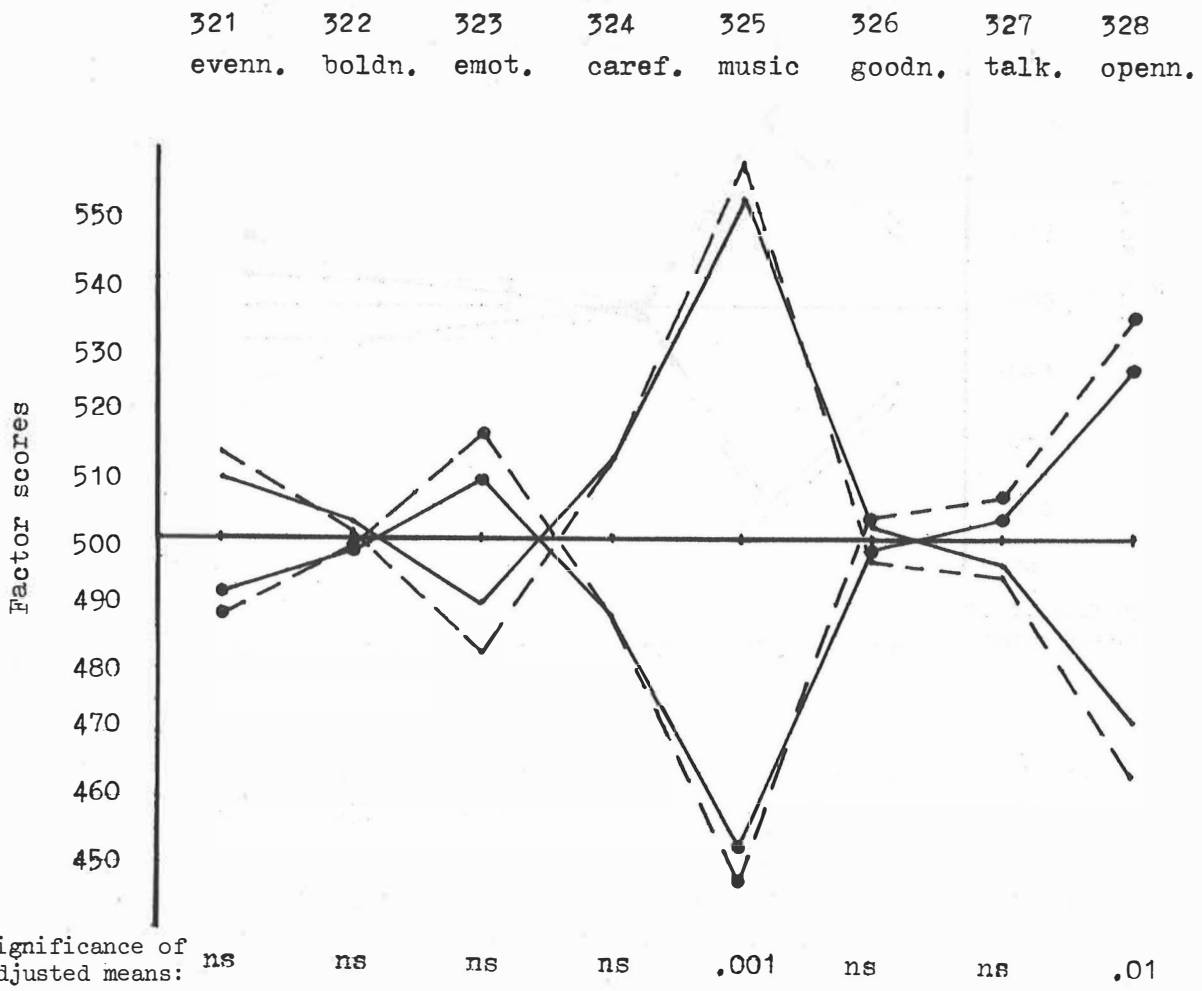


Figure 5. The factor mean profiles of the personality trait factors with the adjusted means and significance levels for both subgroups

4.5.4. Social competence

The covariance analyses with the six social competence factors and the chronological age are shown in abridged form in Appendix 16. The factor mean profiles of the social competence factors are illustrated in Figure 6. Only factor 332 (communication) showed significant difference ($p < .01$) between the groups studied.

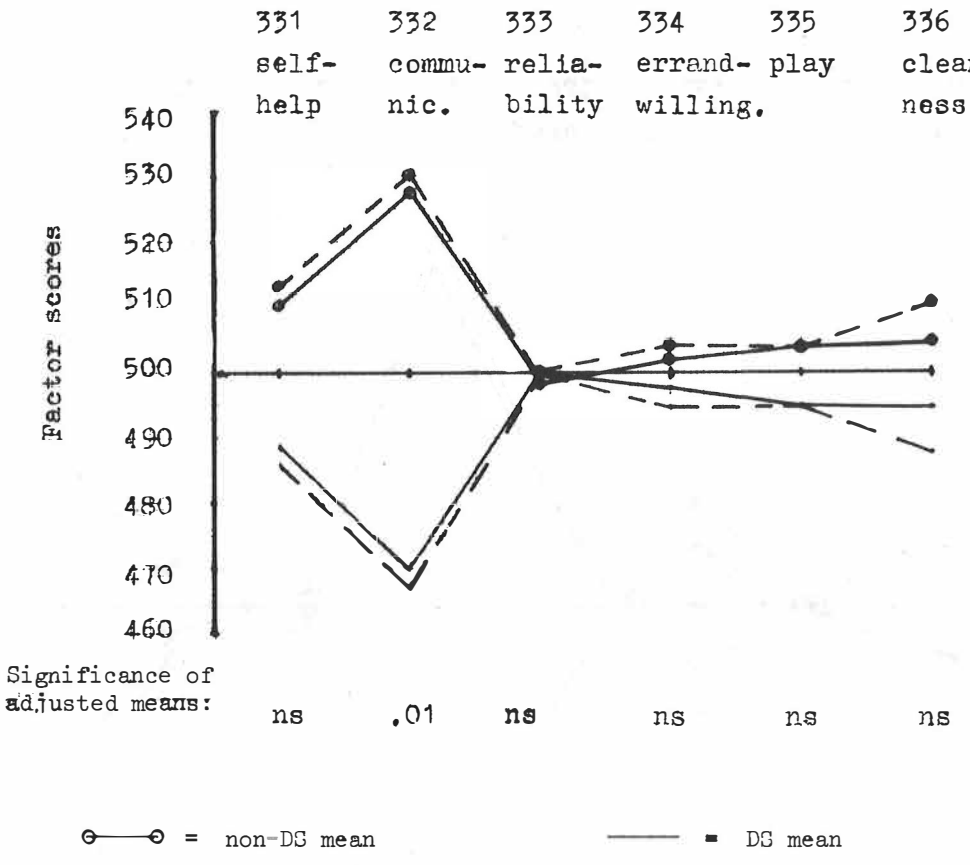


Figure 6. The factor mean profiles of the social competence factors with the adjusted means and significance levels for both subgroups

4.5.5. The covariance analysis with all 23 factors and chronological age

The covariance analysis with all 23 factors and chronological age are presented in abridged from in Appendix 17. Only factors 301 (head), 305 (horizontal breadth), and 312 (psychomotor) were significant on the $p < .001$ level, and 311 (visual perception) and 325 (fondness of music) at the $p < .05$ level.

4.6. An examination of the variances of the measured factors and of the discrimination scores of the different matrices between the DS and non-DS groups

The possible differences in variances between the DS and non-DS groups were examined by calculating the variance ratio of the two groups and testing its significance with the F-test.

The variance ratios of the measured factors and their significance levels are shown in Table 7.

Table 7. The variance ratios of the measured factors and discrimination scores between the DS and non-DS groups

Factor		Variance ratio	p <
301	head	2.627	.002
302	stockiness	1.386 x	ns
303	index	1.087	ns
304	vertical height	1.835	.10
305	horizontal breadth	1.611	.10
311	visual perception	1.233	ns
312	psychomotor	2.539	.002
313	verbal	1.632 x	.10
314	short-term memory	1.278	ns
321	evenness	1.063	ns
322	boldness	1.006	ns
323	emotionalism	1.465 x	ns
324	concentration	1.530	ns
325	fondness of music	1.573 x	ns
326	goodness	1.499 x	ns
327	talkativeness	1.067	ns

continued

Table 7. (continued)

Factor	Variance ratio	p ≤
328 openness	1.478 x	ns
331 self-help	3.814 x	.002
332 communication	1.203 x	ns
333 reliability	1.503	ns
334 errand-willingness	1.478 x	ns
335 play	1.118 x	ns
336 cleanness	1.198 x	ns
Discrimination score		
Physical growth	1.097	ns
Intelligence	1.945	.02
Personality traits	1.065 x	ns
Social competence	1.085 x	ns
23 factor solution	1.450	ns
10 factor solution	1.713	.10

x = variance is greater in DS group

From the figures in Table 7 it can be concluded that the DS and non-DS groups did not have the same variance in factors 301 (head), 312 (psychomotor), and 331 (self-help) and in the discrimination scores of the intelligence matrix.

The figures above mean that DS subjects as a group were more consistent in regard to physical growth and intelligence than the non-DS subjects. The non-DS subjects were on the contrary more consistent in regard to personality traits and social competence than the DS subjects.

4.7. The discriminant analyses with all 23 factors measured and between the sex and type of care groups

The background variables of sex and type of care were analysed only preliminarily and not with the same array of analyses as the DS variable.

The discriminant analyses were made with all 23 factors measured to compare the discrimination powers of the background variables of DS, sex, and of care form. The discriminant analyses were computed with RISKP = 50.0 and 0.0 and are presented for groups of sex in Appendix 18 and for groups of type of care in Appendix 19.

Table 8 gives the discrimination powers of the background variables of DS, of sex and type of care subgroups.

Table 8. The discrimination powers measured with the F-approximation of Wilks Lambda and with $D/\bar{s}$ and with all 23 factors between the DS, sex, and type of care subgroups

Groups	With RISKP = 0.0			With RISKP = 50.0		
	F(23,80)	p <	$D/\bar{s}$	F		p <
Down's syndrome	8.43	.001	3.11	(10,93)	21.23	.001
Sex	3.62	.001	2.02	(11,92)	7.68	.001
Type of care	3.46	.001	1.98	(10,93)	7.88	.001

In the discriminant analysis between the groups of sex, two physical growth factors, 305 (horizontal breadth) and 304 (vertical height), and factor 328 (openness) correlated highest with the discriminator.

In the discriminant analysis between the groups of type of care factors 333 (reliability), 313 (verbal) and 314 (short-term memory) correlated highest with the discriminator.

5. DISCUSSION

The hypotheses and questions presented in chapter 2 have been answered with the findings of the present study and can be shortly described as follows:

1. The four areas measured or rated gave 23 factors including 5 physical growth factors, 4 intelligence factors, 8 personality trait factors and 6 social competence factors.

2. There were significant differences in physical growth, intelligence, personality traits and social competence between the DS and non-DS groups. The most discriminating factors in each area were:

physical growth:	305 (horizontal breadth)
	301 (head)
	304 (vertical height)
	302 (stockiness)
intelligence:	312 (psychomotor)
	313 (verbal)
	311 (visual perception)
person. traits:	325 (fondness of music)
	328 (openness)
	324 (concentration)
	323 (emotionalism)
social competence:	332 (communication)
	331 (self-help)

3. If the descrimination power of the least discriminating area of social competence was used as a unit, the personality trait area discriminated the DS and non-DS groups 3.5 times better, intelligence 6 times better and physical growth 12.5 times better than the social competence area.

4. The combination of the best discriminating factors included the following ten factors arranged according to their discrimination powers:

1) 325 (fondness of music)	6) 302 (stockiness)
2) 312 (psychomotor)	7) 328 (openness)
3) 305 (horiz. breadth)	8) 332 (communication)
4) 301 (head)	9) 311 (visual perception)
5) 304 (vertic. height)	10) 314 (short-term memory)

5. The examination of the relationships across the different areas in canonical analyses revealed only slight overlaps between the areas.

6. The adjusted differences between the group means revealed following highly significant factors:

physical growth: 301 (head)
304 (vertical height)
305 (horizontal breadth)
intelligence: 312 (psychomotor)
Personality traits: 325 (fondness of music)

7. The classification probabilities computed revealed a slight overlap between the groups studied. 4 subjects were classified erroneously as DS and 2 as non-DS, when classified with the factors measured.

8. The physical growth factors were placed first among the best discriminating factors when the sexes were discriminated. Factors 333 (reliability), 314 (short-term memory), and 313 (verbal) were placed first among the best discrminating factors when the type of care groups were discriminated.

The discrimination powers of the sex and type of care variables were nearly three times weaker than the power of the classification according to the DS.

The generality of the findings is restricted by the sampling of measures and subjects. An examination of the first restriction, due to the sampling of measures, showed that of the original variables only the distribution of variable no 21 had not normal values of z, of kurtosis and of skewness.

The two scales especially constructed for the present study, the short-term memory test and the personality trait rating scale, showed tolerable reliabilities. The short-term memory test caused difficulties in the test construction for these low mental age and low motivation levels.

Normal distributions, interval scales and linearity of regressions of the variables are the conditions for the use of the discriminant, canonical correlation and covariance analyses. For the factor scores the first two conditions can be assumed ex definitionem. Only 2.37 % of the 506 regressions of the factor scores did not have linear regressions.

The second restriction of the generality of the findings, due to the sampling of the subjects, is especially serious when individuals of relative rare syndrome of mental retardation are used as subjects. An adequate representativeness of the sample was not obtained and the control of the variability of chronological and mental age, which should be reduced as far as possible, was not secured without loss of subjects.

Of the measurements made, only the variables of intelligence can be a cause of subject loss with tests of semantic, psychomotor, memory, and visual perception abilities. All these eliminate certain types of

moderately and severely mentally retarded subjects. Those who have visual or hearing handicaps, central or peripheral, aphasic, autistic or reactive symptoms or those who are seriously cerebral palsied are not included in the sample. These symptoms are, however, not common among DS subjects as reported by Dey (1971).

In the decisions of factor number in each measurement area several criteria were used. The methods requiring additional computation, mentioned by Horn (1965), Humphreys & Ilgen (1969), and Kaiser (1970) were not used.

The promax-rotations were computed as a check for the orthogonal varimax solutions. The later analyses with the factor scores required orthogonal variables. The promax-rotations gave more precise locations of the factors and made the interpretation easier. The factors were, however, the same in both solutions.

The factors of physical growth can not be directly compared with other factor solutions, but are of the same kind as in the data of Mullen (1939) and as mentioned as a classical example by Harman (1967).

The factors of intelligence were essentially the same as obtained by the author (Kääriäinen 1970a) in the earlier study with DS and non-DS retarded subjects on the same mental age levels and in residential and open care. The short-term memory factor (314) had a visual nature as seen from the factor loadings in Table 4. The direction of the discrimination of factor 311 (visual perception) was opposite to the other intelligence factors and confirms the earlier findings of O'Connor & Hermelin (1961) and the present author (Kääriäinen 1972a).

Factor 312 (psychomotor) was second in the discriminant analysis with the 10 factors and also showed after the covariance adjustments a significant ($p < .001$) difference between the DS and non-DS groups. Factors 313 (verbal) and 311 (visual perception) had nearly significant ($p < .05$) differences between the DS and non-DS groups after the covariance adjustments. The intercorrelations dropped out factor 314 (short-term memory) in the discriminant analysis with the intelligence factors and with RISKP = 50.0, but the same factor was within the 10 best discriminating factors as seen in Appendix 9. It has been a suppressor variable in a new factor combination. The intelligence factors had as a group the second highest discrimination power between the groups studied when measured with F-value of the Wilks Lambda, as seen in Table 6. With the values of $D/\bar{s}$ (Penrose 1951) the factors of intelligence had the third highest discrimination power.

When comparing the discrimination powers of the single factors, it must be remembered that they can not be considered as separate predictors, but are only members of a combination of predictors. Therefore, the discriminant analysis with the 10 factors selected by the program must also be considered as a combination of factors where the intercorrelations can take a suppressor variable into the optimum group of factors (Conger & Jackson 1972, McNemar 1955).

The factors of personality traits describe the subjects as perceived by the ward personnel and must only be understood as such. Of these only factors 325 (fondness of music) and 328 (openness and impulsiveness) were among the 10 best discriminating factors. Factor 325 had the highest discrimination power of all factors studied. This study revealed that the DS group had a special fondness of music and rhythm, showing at the same time a special independency and trickiness in their behavior as several other studies have also shown (Benda 1969, p. 71). This finding was contrary to the findings by Blacketer-Simmonds (1953) and by Cantor & Girardeau (1959).

The social competence scale used revealed six factors with the subjects studied instead of four aspects or areas in the original scale. In the discriminant analysis with all factors and with the RISKP = 50.0 only factors 332 (communication) and 331 (self-help) were in the model. Factor 332 (communication) also had the only significant ($p < .01$) difference in the covariance analysis with the social competence factors and chronological age. The present study did not find that the DS group more frequently exhibit socially competent behavior, as did the study of Johnson & Abelson (1969), but was in agreement with this study with regard to the findings concerning communication.

The canonical correlation and redundance analyses indicated that there were only slight overlaps between the matrices studied. The high canonical correlations can be result of a very large correlation of just one variable of one set with just one variable of the other set and the remainder of the two sets can be essentially uninvolved in the canonical structure. Without redundance analysis the relationship between the two sets of measures can be easily overemphasized (Cooley & Lohnes 1971, p. 176). In spite of the high canonical correlations seen in Appendix 10-12, the actual overlaps between the matrices were small. These overlaps were interpreted in the light of the correlations of the canonical factors with the variables of the matrices and were mainly results of the correlations

between the original factors, such as:

332 communication / 313 verbal

324 carefulness / 336 cleanness

327 talkativeness / 335 play and assistance

304 vertical height / 312 psychomotor

When comparing the discrimination powers of the different solutions with all factors or within the different measurement areas between the groups studied, it is also possible to refer to Penrose (1951) and to his $D/\bar{s}$ index, which was also computed for all solutions with the help of the discrimination scores.

The discriminations which are useful in the study of human genetics are those in which the index $D/\bar{s}$ amounts to more than 3. When the value falls below 2 the effect is not large enough to give any indication of bimodality in the total distribution (Penrose 1951).

Only the $D/\bar{s}$'s of the discriminant analyses with all 23 factors and with 10 optimal factors fulfilled the criterion of Penrose.

The classification errors in the analyses with 10 and 23 factors according to the posteriori probabilities were:

	with 10 factors	with 23 factors
Classifies erroneously as DS	4	4
" " as non-DS	2	4

The discrimination power of the factors measured was not high enough to eliminate the slight overlap between the groups, as seen in Figure 2.

The most important group differences in each measurement area of the present study can be summarized in the following conclusions:

Physical growth:

The DS group was highly significantly smaller in the horizontal breadth dimensions than the non-DS group. Among these horizontal breadth dimensions were: index of span x 100/sitting height, lower face breadth, upper face breadth, and span.

The DS group was significantly shorter in vertical height dimensions (sitting height, height, span, face height) than the non-DS group.

The DS group was significantly smaller in the dimensions of head (maximum circumference, length and breadth of head) than the non-DS group.

The DS group was significantly more stocky than the non-DS group.

Intelligence:

The DS group was significantly slower in the psychomotor factor than the non-DS group.

The DS group was nearly significantly weaker in the verbal factor than the non-DS group.

The DS group was nearly significantly better in the visual perception factor than the non-DS group.

Personality traits:

The DS group was significantly more fond of music and rhythm and more independent and tricky than the non-DS group.

The DS group was significantly weaker in the openness and impulsiveness factor than the non-DS group.

Social competence:

The DS group was significantly weaker in the communication factor than the non-DS group.

The physical growth factors had as a group the highest discrimination power between the groups studied ($F = 22.419$), the intelligence factors the second highest ($F = 10.875$), and the personality trait factors had the third highest discrimination ($F = 6.163$). All these discrimination powers were significant at the $p < .001$ level. The discrimination power of the social competence factors was not significant ($F = 1.777$, $p < .112$).

The examination of the canonical correlations between the measurement matrices showed that there were only slight overlaps between the matrices studied.

There were also significant differences between the groups of sex and type of care on the factors measured. These differences were, however, nearly three times weaker when measured with the F-values than the differences between the DS and non-DS groups.

Most of the findings of the present study have been reported in earlier studies, but some of them have not received proper emphasis. Earlier findings in univariate analyses concern the differences in the dimensions of the head, and of the stockiness and of the vertical height factors between the groups studied. The differences in the psychomotor, verbal and visual perception factors confirmed the earlier finding of the present author with regard to the special nature of the ability structure in DS. Differences in the factor of fondness of music and rhythm and independence and t. ıckiness and in the factor of communication were also reported in earlier studies (Benda 1969). The significant difference in the factor of openness and impulsiveness confirmed the earlier findings of Rollin (1946) in the extraversion/introversion dimensions.

Some of the findings in the present study revealed, however, new relationships. As such can be considered the horizontal breadth factor difference between the DS and non-DS groups, which was the most significant physical growth difference between the groups.

The comparisons of the discrimination powers of the measured matrices can also be considered as such. These comparisons were possible when advanced computer techiniques was available. They also offer wider possibilities for multidiscriplinary research to correlate psychological and bio-clinical data to determine in detail how Down's syndrome cases differ from other retardates and normals. Such an attempt has been made by Klebba (1972). He correlated psychological and bio-clinical data when comparing Down's syndrome with other retardates and normals.

The establishment of syndrome specific behavioral patterns for DS subjects has value for the elaboration of current theoretical issues having to do with somatobehavioral interactions in general.

6. SUMMARY

The present investigation continues the series by the author of Down's syndrome. The following studies have been published earlier:

1. Kääriäinen R. and Dingman, Harvey F. (1961)
The relation of the degree of mongolism to the degree of subnormality. Amer. J. ment. Defic., 66, 438-443.

2. Edgren, J., de la Chapelle, A. and Kääriäinen, R. (1966)
Cytogenetic study of seventy-three patients with Down's syndrome. J. ment. Defic. Res., 10, 47-62

3. Kääriäinen, R. (1970)
The factor structure of intellectual abilities and signal sight vocabulary learning at moderate and severe levels of preliterate mental retardation. Department of Educational Research Gothenburg School of Education. Research Bulletin No 3.

4. Kääriäinen, R. (1972)
Differences in ability factor profiles between mongoloid and nonmongoloid retarded subjects in discriminant analysis and after covariance adjustments. Pedagogiska institutionen vid lärarhögskolan i Göteborg. Uppsats nr. 9.

5. Kääriäinen, R. (1972)
Discrimination learning differences between mongoloid and nonmongoloid mentally retarded subjects. Pedagogiska institutionen vid lärarhögskolan i Göteborg. Uppsats nr. 10.

In his investigation of Down's syndrome (DS), Øster (1953) draws attention to the lack of correlation between the number of physical stigmata of Down's syndrome and the degree of oligophrenia. Investigating this problem further, Gibson and Gibbins (1958) stated that the more mongolian the subject appears, the more intelligence he manifests on psychological examination.

To investigate the relationship between DS stigmata and intelligence the present author selected 5 variables of signs of DS, 5 intelligence measures of DS, and 3 background variables. Pearson's product-moment correlations for these variables were computed for 40 DSsubjects. The correlation matrix was factored by the Thurstone complete centroid process and the junior author, Harvey F. Dingman, adapted the method for the IBM 650. There were seven centroid factors isolated from this matrix of thirteen variables. These centroid factors were rotated using Carroll's oblimin program for the IBM 7090 computer.

The seven factors extracted showed that the degree of mongolism was unrelated to relatively traditional intelligence measures and in contradistinction to the results of Gibson and Gibbins, but consistent with the work of Øster and Dunsdon et al.

The purpose of the second study was to investigate the occurrence of deviating karyotypes in an unselected series of institutionalized patients with Down's syndrome. The sample consisted of seventy-three Down's syndrome patients, thirty females and forty-three males. The first two authors determined the karyotype on the basis of leucosyte cultures carried out according to Hungerford, Donnelly, Nowell and Beck (1959). In cases showing deviations from regular G trisomy and in some cases with minor aberrations of the karyotype, chromosome studies were, in addition,

performed by the skin culture method of Frøland (1961). The chromosome analyses were performed with the aid of drawings and photographs. In those cases in which abnormalities of the karyotype were detected, parents and siblings were studied when available for investigation.

The fifteen morphological signs of Down's syndrome mentioned in the literature were determined for the subjects by the present author. Brief accounts of the clinical findings in those cases of particular interest from the cytogenetic standpoint were also given.

All cases except two had regular G trisomy. One was a normal/G trisomy mosaic, and the other showed triple mosaicism of the type 45/XO//46/XY//47/XY-G trisomy, a hitherto undescribed combination. Minor aberrations of the karyotype were encountered exceptionally frequently.

Study number 3 was made when the author was a member of the Scandinavian research group on special education at the Department of Educational Research of the Gothenburg School of Education to study with a test battery of six hypothetical factors the signal-sight reading learning and the factor structure on preliterate moderate and severe levels of mental retardation. The sample was selected from mentally retarded patients in residential and open care and consisted of 80 male and female subjects.

The principal factor solution with SMC-communalities and the promax analytical oblique rotation were used in the factor analysis of the correlation matrix of the variables. Of the hypothetical factors the following were established empirically: preceptual, memory-quantative, psychomotor and common verbal factors.

In comparing the factor scores in multivariate analysis between clinical and social groups, the generalized analysis of variance showed highly significant differences in the factor profiles between DS and non-DS groups. The multiple correlation between the eight selected tests and the learning variable was significant and showed that 41 per cent of the variance in the learning variable was predictable from the test battery used.

To investigate further the possible differences in patterns between DS and non-DS retarded persons, studies number 4 and 5 were carried out with the covariance and discriminant analyses for the above mentioned subgroups in order to make them more comparable than in the earlier analyses.

Computerized analyses of covariance with multiple covariates and a discriminant analysis were made for the four ability factor scores and chronological age variable. After the covariance adjustments only the psychomotor factor showed a significant difference between the DS and

non-DS subgroups. In the discriminant analysis the psychomotor, memory-quantative and visual perception factors had the greatest relative contributions to the discriminator. The direction of discrimination of the visual perception factor was opposite to the other ability factors.

The results supported the earlier findings obtained in univariate analyses of psychomotor and visual perception differences between these subgroups. The differences obtained in patterns supported the assumption about the special nature of the DS ability structure.

The analysis of covariance with multiple covariates in which the learning variable was the dependent variable and the four ability factors and chronological age independent variables, showed that the difference in discrimination learning between DS and non-DS subgroups was greater than without covariance adjustment, and the result obtained by the DS subjects was significantly better than that of non-DS subjects.

In the discriminant analysis the psychomotor factor and the learning variable had the greatest relative contributions to the discriminator. The obtained results supported the assumption that there must be compensatory mechanisms available to the DS subjects.

The purpose of the present study was to investigate possible pattern differences in measured physical growth factors, in measured intelligence factors, in rated personality trait factors and in rated social competence factors between Down's syndrome and non-Down's syndrome groups of severely and moderately mentally retarded subjects in open and residential care.

The sample consisted of 104 subjects of which 50 were Down's syndrome cases and 54 non-Down's syndrome cases, 55 male and 49 female. 57 cases were in open care, and 47 in residential care. The IQ, sex, chronological and mental age of the subjects were obtained grom the case records and interviews with the personnel.

The measurements of physical growth consisted of 20 anthropometric measurements in the area of head, face, body, and girths. The intelligence test battery consisted of 10 tests, which measured visual perception, verbal, short-term memory, and psychomotor abilities. The personality trait rating scale constructed consisted of 50 items and was completed by the ward personnel as well as the Cain-Levine Social Competence Scale.

The 23 factors of the four areas of physical growth, intelligence, personality traits and social competence were presented and analysed with multivariate techniques. Significant differences were obtained in physical growth, intelligence, personality traits, and social competence

between the DS and the non-DS groups. The most discriminating factors in each area were presented.

Differences between the discrimination powers of the measurement areas were established and compared with each other. The combination of the best discriminating factors was also computed. It consisted of the following 10 factors: fondness of music and rhythm factor, psychomotor factor, four physical growth factors, two personality trait factors and two intelligence factors.

The examination of the relationships across the different areas revealed only slight overlaps between the areas. When the efficiency of the experiments designed was increased with statistical methods there were changes in adjusted differences between the groups studied. There was also a slight overlap between the groups in the classification probabilities computed. There were significant differences between the groups of sex and type of care in the factors measured. These differences were, however, nearly three times weaker than the classification according to Down's syndrome.

It can be concluded that Down's syndrome as a group also differed in behavioral dimensions nearly as systematically as in physical growth dimensions, and pattern differences were found in physical growth, in intelligence, in personality traits, and in social competence areas.

TIIVISTELMÄ

Tässä esitetty työ on jatkoa Downin syndroomaa (DS) käsitteleviin tutkimuksiin, joista on aikaisemmin julkaistu seuraavat:

1. Kääriäinen R. and Dingman Harvey F. (1961)
The relation of the degree of mongolism to the degree of subnormality. Amer. J. ment. Defic., 66, 438-443.

2. Edgren, J., de la Chapelle, A. and Kääriäinen, R. (1966)
Cytogenetic study of seventy-three patients with Down's syndrome. J. ment. Defic. Res., 10, 47-62.

3. Kääriäinen, R. (1970)
The factor structure of intellectual abilities and signal sight vocabulary learning at moderate and severe levels of preliterate mental retardation. Department of Educational Research Gothenburg School of Education. Research Bulletin No 3.

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Differences in ability factor profiles between mongoloid and nonmongoloid retarded subjects in discriminant analysis and after covariance adjustments. Pedagogiska institutionen vid lärarhögskolan i Göteborg. Uppsats nr. 9.

5. Kääriäinen, R. (1972)
Discrimination learning differences between mongoloid and nonmongoloid mentally retarded subjects. Pedagogiska institutionen vid lärarhögskolan i Göteborg. Uppsats nr. 10.

Øster (1953) kiinnittää huomiota DS:aa käsittelevässä tutkimuksessaan korrelaation puuttumiseen DS:n fyysisten stigmojen ja oligofremian asteen väliltä. Tutkiessaan tätä kysymystä Gibson ja Gibbins (1958) totesivat, että mitä enemmän koehenkilöt osoittivat DS:n stigmoja, sitä enemmän he osoittivat älykkyyttä psykologisissa testeissä.

Edellä ensimmäisenä mainittu tutkimus tehtiin DS:n stigmojen ja älykkyyden välisten suhteiden selvittämiseksi. Siinä valittiin viisi DS:n stigmamuuttujaa, viisi älykkyys- ja kolme taustamuuttujaa, joiden väliset

Pearsonin tulomomenttikorrelaatiot laskettiin aineistolla, jossa oli 40 DS-tapausta. Korrelaatiomatriisi faktoroitiin Thurstonen täydellisellä sentroidimenetelmällä, ja toinen tutkimuksen tekijöistä, Harvey F. Dingman, sovelsi menetelmän IBM 650:lle. Matriisista osoitettiin seitsemän sentroidifaktoria, jotka rotatoitiin käyttäen Carrollin oblimin ohjelmaa IBM 7090:lle. Nämä seitsemän faktoria osoittivat, että DS:n aste oli riippumaton traditionaalisista älykkyysmittauksista ja ristiriidassa Gibsonin ja Gibbinsin saamiin tuloksiin nähden, mutta yhdenmukainen Østerin ja Dunsdon et al:n saamien tulosten kanssa.

Toisena mainitun tutkimuksen tarkoituksena oli tutkia poikkeavia karyotyyppejä laitoshoidossa olevalla DS-aineistolla. Näytteessä oli 73 DS-tapausta, 30 naista ja 43 miestä. Kaksi tutkimuksen ensinmainittua tekijää määrittivät karyotyypin leukosyyttiviljelystä, joka oli tehty Hungerfordin, Donnellyn, Nowellin ja Beckin mukaan (1959). Niissä tapauksissa, joissa oli poikkeamaa normaalista G-trisomiasta, sekä eräissä pienissä karyotyyppipoikkeamissa tehtiin lisäksi kromosomimääritykset myös ihoviljelyistä Frølandin (1961) menetelmän mukaan. Kromosomianalyysit tehtiin piirrosten ja valokuvien avulla. Niissä tapauksissa, joissa karyotyyppi oli poikkeava, tutkittiin myös vanhemmat ja sisaret, mikäli se oli mahdollista. Tämän tutkimuksen tekijä määritti jokaisessa DS-tapauksessa 15 kirjallisuudessa mainittua DS:aan liittyvää morfologista piirrettä. Kliinisistä piirteistä annettiin myös lyhyt selvitys niissä tapauksissa, jotka olivat sytologisesti mielenkiintoisia. Kahta tapausta lukuunottamatta olivat kaikki koehenkilöt säännöllisiä G-trisomiamuotoja. Toinen oli normaali / G-trisomia mosaiikkitapaus ja toinen kolmoismosaiikkityyppiä 45/XO//46/XY//47/XY-G-trisomia, jollaista ei aikaisemmin kirjallisuudessa ollut mainittu. Karyotyypin vähäisempiä poikkeavuuksia löytyi poikkeuksellisen runsaasti.

Kolmantena mainittu tutkimus syntyi tämän tutkimuksen tekijän ollessa yhteispohjoismaisen erityispedagogisen tutkijaryhmän jäsenenä pedagogisessa tutkimuslaitoksessa Göteborgissa. Tarkoituksena oli tutkia syvästi vajaamielisillä ns. signaalilukemisen oppimista ja älyllistä faktorirakennetta testistöllä, jossa oli 6 hypoteettista älykkyysfaktoria. Tutkitussa näytteessä oli 80 koehenkilöä, kumpaakin sukupuolta avo- ja laitoshoidon piiristä. Älykkyystestistön faktorianalyysissä käytettiin pääakselimenetelmää, SMC-kommunaliteetteja ja analyyttistä promaxvinorotaatiota. Hypoteettisista faktoreista seuraavat osoitettiin empiirisesti: näköhahmotus-, muisti-kvantitatiivinen, psykomotorinen ja yleinen verbaalinen faktori. Vertailtaessa faktoripisteitä multivariaatioanalyyseillä kliinisissä ja

sosiaalisissa ryhmissä, osoitti yleinen varianssianalyysi erittäin merkitsevän eron DS- ja ei-DS-ryhmien välillä faktoriprofiilissa. Yhteiskorrelaatio valitun 8 testin ja oppimisvariaabelin välillä oli merkitsevä ja osoitti, että 41 % oppimisvariaabelin varianssista oli ennustettavissa käytetyllä testistöllä.

Neljäntenä ja viidentenä mainittujen tutkimusten tarkoituksena oli analysoida edelleen mahdollisia faktorirakenne-eroja DS- ja ei-DS-ryhmien välillä kovarianssi- ja erotteluanalyyseillä. Neljälle kykyfaktorille ja kronologiselle iälle tehtiin kovarianssianalyysi yhteiskovariaateilla ja erotteluanalyysi. Kovarianssikorjauksen jälkeen vain psykomotorinen faktori osoitti merkitsevää eroa DS- ja ei-DS-ryhmien välillä. Psykomotorisella, muisti-kvantitatiivisella ja näköhahmotusfaktorilla oli suurimmat suhteelliset osuudet erottelufunktion suhteen. Näköhahmotusfaktorin erottelun suunta oli vastakkainen muihin kykyfaktoreihin verrattuna. Tulokset tukivat aikaisempia havaintoja univariaatioanalyyseissä psykomotoristen ja näköhahmotuserojen suhteen tutkittujen ryhmien välillä. Saadut tulokset tukivat myös oletusta DS:n erityisestä kykyrakenteesta.

Yhteiskovariaateilla suoritettu kovarianssianalyysi, jossa oli mukana oppimisvariaabeli riippuvana variaabelina ja neljä kykyfaktoria ja kronologinen ikä riippumattomina variaabeleina, osoitti, että oppimiserot DS- ja ei-DS-ryhmien välillä olivat suuremmat kuin ilman kovarianssikorjausta ja oppiminen oli merkitsevästi parempaa DS-ryhmällä kuin ei-DS-ryhmällä, vaikka kykyprofiilierot olivat merkitsevästi päinvastaisia. Erotteluanalyysissä oli psykomotorisella faktorilla ja oppimisvariaabelilla suurimmat suhteelliset osuudet erottelufunktion suhteen. Saadut tulokset tukivat oletusta siitä, että DS-ryhmällä täytyi olla kompensoivia mekanismeja, jotta tällainen tulos selittyisi.

Tässä esitetyn työn tarkoitus oli tutkia edelleen mahdollisia eroja avo- ja laitoshoidossa olevilla syvästi vajaamielisillä DS- ja ei-DS-ryhmillä mitatuissa fyysisen kasvun faktoreissa, mitatuissa älykkyysfaktoreissa, arvioiduissa persoonallisuuspiirrefaktoreissa ja arvioiduissa sosiaalisen kompetenssin faktoreissa. Tutkitussa näytteessä oli 104 koehenkilöä, joista 50 DS- ja 54 ei-DS-tapausta. Heistä oli miehiä 55 ja naisia 49. Näytteestä oli avohuollossa 57 ja laitoshoidossa 47. Koehenkilöiden älyllinen taso ja kronologinen ikä saatiin sairaskertomuksista ja henkilökunnan haastatteluista.

Fyysisen kasvun mittaukset käsittivät 20 antropometristä mittausta pään, kasvojen, kehon ja ympärysmittausten alueilta. Älykkyystestistössä

oli 10 testiä, jotka mittasivat näköhahmotusta, verbaalisuutta, lyhytkestoista muistia ja psykomotoriikkaa. Persoonallisuuspiirteiden arviointiskaalassa oli 50 osatehtävää. Hoitohenkilökunta arvioi persoonallisuuspiirteet sekä sosiaalisen kompetenssin Cain-Levinen testillä, jossa oli 44 osatehtävää.

Fyysisen kasvun, älykkyyden, peroonallisuuspiirteiden ja sosiaalisen kompetenssin alueilta saatuja 23 faktoria analysoitiin multivariaatiomenetelmin. Kaikilla edellä mainituilla alueilla saatiin merkitseviä eroja DS- ja ei-DS-ryhmien välillä. Kunkin alueen eniten erottelevat faktorit tutkittiin. Eri mittausalueiden väisiä eroja erottelun voimakkuudessa vertailtiin ryhmien välillä. Myös ryhmiä parhaiten erotteleva faktorikombinaatio laskettiin, ja siinä olivat seuraavat kymmenen faktoria: pitää musiikista ja rytmiikasta -faktori, psykomotorinen faktori, neljä fyysisen kasvun faktoria, kaksi persoonallisuuspiirrefaktoria ja kaksi älykkyysfaktoria.

Eri mittausalueiden välistä riippuvuutta koskeva analyysi osoitti vain vähäistä alueiden välistä päällekkäisyyttä. Ryhmien verrantamisessa syntyneitä eroja korjattiin tilastollisin keinoin ja lisättiin siten vertailujen tehokkuutta. Kyn ryhmien välinen luokittelu tehtiin mitattujen faktoripistemäärien perusteella, esiintyi pientä ryhmien välistä päällekkäisyyttä. Ryhmiteltäessä koehenkilöt sukupuolen ja hoitomuodon mukaan saatiin mitatuissa faktoreissa merkitseviä eroja ryhmien välille. Nämä erot olivat kuitenkin erottelun voimakkuudessa lähes kolme kertaa heikompia kuin DS:n mukaisen ryhmittelyn väliset erot.

Tutkimus osoitti eroja DS- ja ei-DS-ryhmien välillä fyysisessä kasvussa, älykkyydessä, persoonallisuuspiirteissä ja sosiaalisessa kompetenssissa. Downin syndrooma erosi kontrolliryhmästä myös käyttäytymisdimensioissa lähes yhtä systemaattisesti kuin fyysisen kasvun dimensioissa.

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APPENDICES

Appendix 1. The numbers of the variables and factors used

Variables

1. Down's syndrome
2. Sex
3. Type of care
4. Chronological age
5. - 24. Physical growth; see Table 2
25. - 34. Intelligence; see Table 3
35. - 84. Personality traits; see Table 4
85. - 128. Social competence; see Table 5

Factors

301 head
302 stockiness
303 index
304 vertical height
305 horizontal breadth
311 visual perception
312 psychomotor
313 verbal
314 short-term memory
321 evenness
322 boldness
323 emotionalism
324 concentration
325 fondness of music
326 goodness
327 talkativeness
328 openness
331 self-help
332 communication
333 reliability
334 errand-willingness
335 play and assistance
336 cleanness

Appendix 2. The means, standard deviations, measures of skewness, degrees of kurtosis and z-values of the variables used. N = 104.

Variable	Mean	SD	Skewness	Kurtosis	z
5.	175.74	10.60	0.56	0.72	-1.36
6.	144.41	6.65	0.43	0.79	0.02
7.	529.87	24.72	0.66	1.73	-1.02
8.	823.12	45.23	-0.50	- 0.05	0.21
9.	122.70	6.24	-0.06	0.45	-0.65
10.	97.92	6.23	0.00	0.04	-0.06
11.	106.27	10.38	0.40	- 0.50	1.41
12.	837.78	65.41	0.31	- 0.13	0.59
13.	1530.04	131.85	0.06	- 0.38	1.06
14.	510.04	122.45	0.07	- 0.40	0.54
15.	3145.42	649.76	0.67	- 0.00	-0.25
16.	811.72	64.99	0.17	- 0.60	0.96
17.	884.67	69.52	0.04	- 0.21	0.23
18.	1503.10	151.94	0.09	- 0.41	0.93
19.	1850.69	106.27	0.04	- 0.17	0.64
20.	815.27	83.18	-0.02	- 0.44	0.98
21.	724.95	113.76	-2.05	13.26	-5.63
22.	511.57	65.16	0.07	- 0.34	0.22
23.	230.36	24.59	0.10	- 0.76	2.31
24.	1005.27	84.46	0.53	1.20	-1.99
25.	31.62	8.62	0.83	0.84	-0.05
26.	6.81	2.50	0.49	0.59	-0.05
27.	11.08	2.79	-0.15	- 0.27	0.97
28.	19.61	4.19	-0.13	- 0.11	-0.26
29.	48.89	6.03	-0.74	0.45	-0.11
30.	74.99	12.62	-0.95	0.97	-0.44
31.	11.22	4.69	-0.25	- 1.10	3.16
32.	9.55	7.07	1.11	1.45	1.12
33.	6.52	2.64	0.20	- 0.20	0.47
34.	27.01	15.98	0.30	- 0.77	0.60
35.	1.26	1.05	-1.62	3.25	
36.	0.72	1.41	-0.73	- 0.55	
37.	0.63	1.49	-0.62	- 0.78	
38.	0.31	1.60	-0.32	- 1.20	

continued

Appendix 2 (continued)

Variable	Mean	SD	Skewness	Kurtosis	z
39.	0.61	1.62	-0.36	- 0.99	
40.	1.17	1.50	-0.76	- 0.50	
41.	0.74	1.46	-0.52	- 0.67	
42.	0.58	1.68	-0.65	- 0.86	
43.	0.13	1.68	-0.24	- 1.28	
44.	0.45	1.69	-0.46	- 1.35	
45.	0.42	1.59	-0.39	- 1.06	
46.	- 0.27	1.47	0.36	- 1.08	
47.	- 0.15	1.51	0.32	- 1.07	
48.	- 0.28	1.41	0.35	- 1.16	
49.	0.78	1.47	-1.00	0.15	
50.	0.33	1.38	-0.39	- 1.03	
51.	1.37	0.85	-0.89	0.92	
52.	1.03	1.26	-0.73	- 0.24	
53.	0.55	1.50	-0.59	- 0.79	
54.	1.26	1.12	-0.95	0.61	
55.	0.65	1.37	-0.75	- 0.47	
56.	0.44	1.49	-0.36	- 1.14	
57.	0.51	1.41	-0.64	- 0.70	
58.	- 0.14	1.37	0.28	- 1.02	
59.	0.04	1.70	-0.40	- 1.17	
60.	0.08	1.38	-0.37	- 0.75	
61.	0.05	1.64	-0.13	- 1.29	
62.	1.43	0.70	-1.00	2.18	
63.	1.11	1.31	-0.59	- 0.41	
64.	0.29	1.46	-0.19	- 1.06	
65.	0.28	1.54	-0.23	- 1.21	
66.	0.26	1.42	0.01	- 1.31	
67.	1.08	1.33	-0.92	- 0.20	
68.	- 0.47	1.35	0.61	- 0.78	
69.	0.11	1.64	0.02	- 1.33	
70.	0.02	1.82	-0.16	- 1.41	
71.	0.93	1.56	-0.52	- 0.99	
72.	1.07	1.25	-1.02	0.11	
73.	- 0.18	1.25	0.02	- 1.20	

continued

Appendix 2 (continued)

Variables	Mean	SD	Skewness	Kurtosis	z
74.	0.21	1.35	-0.29	- 1.17	
75.	- 0.07	1.41	0.19	- 0.91	
76.	- 0.07	1.65	0.13	- 1.32	
77.	0.62	1.38	-0.56	- 0.94	
78.	0.81	1.29	-1.02	0.68	
79.	1.22	1.21	-0.68	- 0.21	
80.	1.07	1.21	-0.92	0.11	
81.	0.64	1.24	-0.84	- 0.10	
82.	0.79	1.15	-0.46	- 0.72	
83.	0.79	1.34	-0.73	- 0.43	
84.	- 0.86	1.30	0.95	0.27	
85.	4.41	0.87	-1.77	3.35	
86.	3.35	0.99	-1.29	0.30	
87.	3.82	0.46	-3.31	13.11	
88.	3.89	0.41	-4.76	25.40	
89.	2.89	0.88	-0.20	- 0.96	
90.	4.46	0.80	-1.57	1.91	
91.	3.70	0.67	-1.96	2.06	
92.	3.45	0.81	-1.42	1.18	
93.	3.84	0.53	-3.55	11.93	
94.	3.77	0.49	-2.21	4.09	
95.	3.44	0.71	-1.35	1.89	
96.	3.30	0.87	0.12	0.43	
97.	4.04	0.80	-0.98	1.57	
98.	3.60	0.67	-1.82	3.19	
99.	3.02	0.82	-0.46	- 0.48	
100.	2.68	0.99	-0.04	- 1.13	
101.	2.94	0.97	-0.50	- 0.83	
102.	2.81	1.00	-0.36	- 0.98	
103.	2.94	1.10	-0.52	- 1.15	
104.	3.22	0.90	-0.83	- 0.42	
105.	3.23	0.81	-0.76	- 0.17	
106.	3.23	1.26	0.18	- 1.25	
107.	2.71	0.98	-0.05	- 1.13	
108.	3.34	0.90	-1.12	0.06	

continued

Appendix 2 (continued)

Variable	Mean	SD	Skewness	Kurtosis	z
109.	2.46	0.97	0.23	- 0.94	
110.	2.96	0.82	-0.45	- 0.32	
111.	2.18	1.08	0.40	- 1.13	
112.	2.60	0.83	0.15	- 0.69	
113.	3.22	1.16	-0.06	- 0.86	
114.	2.71	0.91	-0.14	- 0.84	
115.	2.58	0.87	0.21	- 0.79	
116.	2.53	0.96	0.11	- 0.97	
117.	2.51	0.94	0.18	- 0.90	
118.	2.45	0.77	0.03	- 0.38	
119.	2.90	0.89	0.18	- 1.72	
120.	3.16	0.86	-0.32	- 1.59	
121.	3.59	0.62	-1.29	0.52	
122.	3.44	0.67	-0.81	- 0.50	
123.	3.26	0.83	-1.11	0.83	
124.	3.52	0.60	-0.89	- 0.20	
125.	3.32	0.67	-0.68	0.17	
126.	3.34	0.76	-1.18	1.23	
127.	3.13	0.63	-0.56	1.19	
128.	3.08	0.77	-0.27	- 0.93	
			SE = 0.24	SE = 0.48	

Appendix 3. Eigenvalues of the matrices used

Matrices	With 1.00 in diagonal		With communality estimates in diagonal	
Physical growth	eigenv.	cum % of trace	eigenv.	% of trace
1.	8.52	42.6	8.40	19.1
2.	3.88	62.0	3.75	33.3
3.	2.79	76.0	2.75	18.1
4.	1.37	82.9	1.18	20.5
5.	0.88	87.3	0.65	9.0
6.	0.70	90.8		
7.	0.45	93.0		
Intelligence				
1.	4.74	47.4	4.43	34.3
2.	1.24	59.8	0.81	21.8
3.	0.97	69.5	0.57	34.2
4.	0.79	77.5	0.37	9.7
5.	0.62	83.6		
6.	0.49	88.5		
Personality traits				
1.	15.31	30.6	15.05	29.1
2.	8.18	47.0	7.85	15.8
3.	3.31	53.6	2.97	8.4
4.	2.99	59.6	2.68	14.9
5.	1.92	63.4	1.55	3.9
6.	1.45	66.3	1.16	8.8
7.	1.35	69.0	1.01	16.3
8.	1.18	71.4	0.75	2.8
9.	1.00	73.4		
Social competence				
1.	15.06	34.2	14.76	26.2
2.	5.03	45.7	4.75	23.0

continued

Appendix 3 (continued)

	With 1.00 in diagonal		With communality estimates in diagonal	
Social competence	eigenv.	cum % of trace	eigenv.	% of trace
3.	3.63	53.9	3.37	9.0
4.	1.88	58.2	1.56	6.8
5.	1.60	61.9	1.30	13.8
6.	1.49	65.3	1.19	21.2
7.	1.25	68.1		
8.	1.19	70.8		
9.	1.14	73.4		

Appendix 4. The factor score correlations with chronological age in the total sample and in DS and non-DS groups

Factor		N = 104 Total	N = 54 non-DS	N = 50 DS
301	head	-.02	-.03	.04
302	stockiness	.54^{xxx}	.45^{xxx}	.61^{xxx}
303	index	-.13	-.13	-.15
304	vertical height	.32^{xx}	.47^{xxx}	.28^{x}
305	horizontal breadth	.05	.03	.16
311	visual perception	.07	.14	-.01
312	psychomotor	.13	.25	.13
313	verbal	.22^{x}	.06	.36^{x}
314	short-term memory	-.21^{x}	-.22	-.19
321	evenness	-.11	-.00	-.21
322	boldness	.09	-.04	.20
323	emotionalism	.23^{x}	.34^{x}	.15
324	concentration	.23^{x}	.18	.28^{x}
325	fondness of music	-.06	-.13	-.08
326	goodness	.34^{xx}	.15	.48^{xxx}
327	talkativeness	.02	.04	.02
328	openness	.06	-.09	.20
331	self-help	.15	-.04	.25
332	communication	.14	.13	.20
333	reliability	.09	.06	.12
334	errand-willingness	.14	.22	.08
335	play	.06	.23	-.08
336	cleanness	.49^{xxx}	.38^{xx}	.59^{xxx}

xxx = $p < .001$ xx = $p < .01$ x = $p < .05$

The differences between the subgroup correlations are not significant.

Appendix 5. The discriminant analyses with the five factor scores of physical growth and between the DS and non-DS groups

Tests for equality of means and additional information

Factor	eq. of means	ad.inf.	RISKP
305 horiz. breadth	F(1,102) = 26.62	F(1,106) = 74.21	1.00
301 head	F(2,101) = 25.48	F(2,104) = 22.09	1.00
304 ver. height	F(3,100) = 28.53	F(3,102) = 5.27	.99
302 stockiness	F(4,99) = 27.95	F(4,100) = 0.16	.04
- - -			
303 index	F(5,98) = 22.41	F(5,98) = 0.00	.00

F-test for equality of covariance matrices

F (15, ∞) = 7.01 p < .001

Eigenvalues	%	Chi-square	df	p<	Canonical cor.	RISKP
1.14	100.0	76.64	5	.001	.73	0.0
1.12	100.0	76.34	4	.001	.72	50.0

Discrimination function coefficients

301	302	303	304	305
.66	-.50	-.11	.66	.70

Correlations between discriminating functions and variables

301	302	303	304	305
.51	-.36	-.07	.55	.62

Discriminant scores (RISKP = 0.0)

	mean	SD	$D/\bar{s}$ = 2.12
DS group	386.93	97.55	
Non-DS group	601.92	102.21	

Appendix 6. The discriminant analyses with the four factors of intelligence and between the DS and non-DS groups

Tests for equality of means and additional information

Factor	eq. of means	ad. inf.	RISKP
312 psychomotor	F(1,102) = 33.64	F(1,105) = 8.65	.99
313 verbal	F(2,101) = 18.85	F(2,103) = 2.47	.91
311 vis. perc.	F(3,100) = 13.58	F(3,101) = 0.76	.48
- - -			
314 short-t. mem.	F(4,99) = 10.87	F(3,101) = 0.00	.00

F-test for equality of covariance matrices

F(10, ∞) = 5.70 p < .001

Eigenvalues	%	Chi-square	df	p <	Canonical cor.	RISKP
.43	100.0	36.79	4	.001	.55	0.0
.40	100.0	34.70	3	.001	.53	50.0

Discrimination function coefficients

311	312	313	314
-.33	.93	.34	.27

Correlations between discriminating functions and variables

311	312	313	314
-.13	.90	.36	.18

Discriminant scores (RISKP = 0.0)

	mean	SD	$D/\bar{s}$ = 1.34
DS group	431.78	81.88	
Non-DS group	563.17	114.22	

Appendix 7. The discriminant analyses with the eight personality trait factors and between the DS and non-DS groups

Tests for equality of means and additional information

Factor		eq. of means	ad. inf.	RISKP
325	fond. of music	F(1,102) = 33.81	F(1,109) = 15.35	.99
328	openness	F(2,101) = 22.67	F(2,107) = 2.58	.91
324	concentration	F(3,100) = 15.92	F(3,105) = 0.97	.59
323	emotionalism	F(4,99) = 12.33	F(4,103) = 0.35	.15
- - -				
321	evenness	F(5,98) = 10.06	F(5,101) = 0.07	.00
327	talkativeness	F(6,97) = 8.35	F(6,99) = 0.02	.00
322	boldness	F(7,96) = 7.10	F(7,97) = 0.01	.00
326	goodness	F(8,95) = 6.16	F(8,95) = 0.00	.00

F-test for equality of covariance matrices

$F(36, \infty) = 2.25$ $p < .001$

Eigenvalues	%	Chi-square	df	p<	Canonical cor.	RISKP
.51	100.0	41.39	8	.001	.58	0.0
.49	100.0	40.84	4	.001	.57	50.0

Discrimination function coefficients

321	322	323	324	325	326	327	328
-.17	-.05	.19	-.24	-.89	-.04	.08	.49

Correlations between discriminating functions and variables

321	322	323	324	325	326	327	328
-.14	-.03	.16	-.20	-.85	-.02	.06	.46

Discriminant scores (RISKP = 0.0)

	mean	SD	$D/\bar{s} = 1.42$
DS group	425.86	101.63	
Non-DS group	568.65	98.46	

Appendix 8. The discriminant analyses with the six social competence factors and between the DS and non-DS groups

Tests for equality of means and additional information

Factor	eq. of means	ad. inf.	RISKP
332 communication	F(1,102) = 9.33	F(1,107) = 1.79	.81
331 self-help	F(2,101) = 5.32	F(2,105) = 0.21	.19
- - -			
336 cleanness	F(3,100) = 3.59	F(3,103) = 0.06	.02
335 play	F(4,99) = 2.70	F(4,101) = 0.01	.00
333 reliability	F(5,98) = 2.15	F(5,99) = 0.00	.00
334 err.-willingn.	F(6,97) = 1.77	F(6,97) = 0.00	.00

F-test for equality of covariance matrices

$F(21, \infty) = 2.99$ $p < .001$

Eigenvalues	%	Chi-square	df	p<	Canonical cor.	RISKP
.10	100.0	10.43	6	.108	.31	0.0
.10	100.0	10.22	2	.006	.30	50.0

Discrimination function coefficients

331	332	333	334	335	336
.35	.92	-.04	.04	.12	.14

Correlations between discriminating functions and variables

331	332	333	334	335	336
.34	.92	-.03	.06	.12	.16

Discriminant scores (RISKP = 0.0)

	mean	SD	$D/\bar{s} = 0.65$
DS group	465.88	102.11	
Non-DS group	531.59	98.00	

Appendix 9. The discriminant analysis with all 23 factors measured and between the DS and non-DS groups. RISKP = 50.0

Tests for equality of means and additional information

Factor		eq. of means	ad. inf.	RISKP
325	fondness of music	F(1,102) = 33.81	F(1,124) = 195.02	1.00
312	psychomotor	F(2,101) = 31.53	F(2,122) = 67.63	1.00
305	horiz. breadth	F(3,100) = 31.94	F(3,120) = 29.97	1.00
301	head	F(4,99) = 30.44	F(4,118) = 15.81	1.00
304	vertical height	F(5,98) = 28.42	F(5,116) = 9.23	1.00
302	stockiness	F(6,97) = 27.96	F(6,114) = 4.85	.99
328	openness	F(7,96) = 25.84	F(7,112) = 3.00	.99
332	communication	F(8,95) = 23.93	F(8,110) = 1.86	.92
311	visual perc.	F(9,94) = 22.56	F(9,108) = 1.00	.56
314	short-t. m.	F(10,93) = 21.23	F(10,106)= 0.45	.08

F-test for equality of covariance matrices

$F(276, \infty) = 1.70$ $p < .001$

Eigenvalues	%	Chi-square	df	p<	Canonical cor.	RISKP
2.28	100.0	116.5	10	.001	.83	50.0

Discrimination function coefficients

301	302	304	305	311	314	325	328	332
-.60	.34	-.40	-.73	.33	-.21	.32	-.26	-.27

Correlations between discriminating functions and variables

301	302	304	305	311	314	325	328	332
-.44	.31	-.48	-.54	.08	-.12	.59	-.32	-.34

Discriminant scores (RISKP = 50.0)

	mean	SD	$D/\bar{s}$ = 3.03
DS group	344.48	85.41	
Non-DS group	644.00	111.80	

Appendix 10. The canonical correlation analyses between the matrices of physical growth and intelligence

Variables	Correlations with variables		
	DS	non-DS	Total
	Canonical correlation		
	1 ns	1	1
Physical growth			
301 head		- .20	- .29
302 stockiness		- .39	.02
303 index		.13	.41
304 vertical height		- .05	- .73
305 horizontal breadth		- .79	- .54
Redundance		.055	.047
Intelligence			
311 visual perception		- .42	- .10
312 psychomotor		.20	- .85
313 verbal		- .78	- .59
314 short-term memory		.49	.02
Redundance		.090	.059
Canonical R		.57	.46
Chi-square		30.59	38.26
df		20	20
p <		.10	.01

Appendix 11. The canonical correlation analyses between the matrices of personality traits and physical growth

Variables	Correlations with variables		
	DS	non-DS	Total
	Canonical correlation		
	1	1	1
Personality traits			
321 evenness	.50	- .25	- .09
322 boldness	.35	- .17	- .16
323 emotionalism	- .26	- .77	- .12
324 concentration	- .49	- .25	- .35
325 fondness of music	- .35	- .14	- .82
326 goodness	- .38	- .26	- .06
327 talkativeness	- .21	- .19	- .14
328 openness	- .51	.08	.39
Redundance	.063	.034	.038
Physical growth			
301 head	.09	.60	.60
302 stockiness	- .54	.01	- .37
303 index	.83	.63	.15
304 vertical height	- .08	- .49	.58
305 horizontal breadth	.07	.21	.45
Redundance	.081	.065	.064
Canonical R	.63	.55	.54
Chi-square	45.71	40.58	61.22
df	40	40	40
p<	.05	.10	.001

Appendix 12. The canonical correlation analyses between the matrices of intelligence and those of personality traits and social competence

Variables	Correlations with variables					
	DS		non-DS		Total	
	Canonical correlation					
	1	2	1	2	1	2
Pers. traits and social competence						
321 evenness	- .44	.22	- .17	.17	- .11	- .31
322 boldness	.04	- .11	- .16	- .02	.13	- .24
323 emotionalism	.02	- .49	- .30	- .04	.23	.13
324 concentration	.01	- .14	- .32	- .11	.14	- .41
325 fondness of mus.	- .11	- .28	.33	- .1	- .45	- .14
326 goodness	.21	- .26	- .08	- .39	.12	- .13
327 talkativeness	.19	- .35	.09	.52	.09	.26
328 openness	- .12	- .09	.28	.11	- .04	.18
331 self-help	.34	- .26	- .34	- .40	.39	- .13
332 communication	.65	.10	- .42	.20	.63	.09
333 reliability	.13	.06	- .32	.42	.27	- .04
334 errand-willingn.	.42	- .12	- .52	.00	.43	.15
335 play	- .28	- .42	- .32	.46	.12	- .28
336 cleanness	- .02	- .48	- .34	- .24	.21	- .59
Redundance	.048	.025	.068	.034	.050	.020
Intelligence						
311 visual percept.	.12	.29	- .47	.20	.32	- .46
312 psychomotor	.13	- .91	- .63	- .45	.58	.05
313 verbal	.95	.10	- .74	.51	.84	.08
314 short-term m.	.28	.48	.19	.70	.07	.78
Redundance	.152	.106	.217	.102	.169	.059
Canonical R	.77	.60	.84	.63	.76	.53
Chi-square	83.18	46.72	103.16	48.19	142.68	59.03
df	56	39	56	39	56	39
p<	.001	.05	.001	.02	.001	.01

Appendix 13. The covariance analyses with multiple covariates. The five physical growth factors and chronological age

Variable		Group	Mean	Adj.mean	F(1,97)	p <
301	head	non-DS	536.00	557.56	26.39	.001
		DS	461.08	437.78		
302	stockiness	non-DS	474.72	471.45	6.75	.05
		DS	527.36	530.89		
303	index	non-DS	494.81	486.83	0.89	ns
		DS	505.68	514.29		
304	vertical height	non-DS	537.09	551.81	26.56	.001
		DS	458.00	442.10		
305	horiz. breadth	non-DS	543.55	560.59	32.73	.001
		DS	452.92	434.52		
Age		non-DS	193.01	191.02	0.89	ns
		DS	198.04	200.18		

Appendix 14. The covariance analyses with multiple covariates. The four factors of intelligence and chronological age

Variable		Group	Mean	Adj.mean	F(1,98)	p <
311	visual perc.	non-DS	498.42	485.17	2.59	ns
		DS	507.72	522.03		
312	psychomotor	non-DS	547.72	551.09	37.32	.001
		DS	448.52	444.87		
313	verbal	non-DS	519.07	524.23	5.08	.05
		DS	479.38	473.80		
314	short-term m.	non-DS	509.85	511.78	1.13	ns
		DS	489.28	487.19		
Age		non-DS	193.01	188.25	2.47	ns
		DS	198.04	203.18		

Appendix 15. The covariance analyses with multiple covariates. The eight personality trait factors and chronological age.

Variable		Group	Mean	Adj.mean	F(1,94)	p <
321	evenness	non-DS	491.74	488.48	0.0	ns
		DS	509.00	512.51		
322	boldness	non-DS	498.14	498.99	0.0	ns
		DS	502.00	501.10		
323	emotionalism	non-DS	509.37	516.05	1.89	ns
		DS	489.80	482.58		
324	concentration	non-DS	488.27	488.16	1.00	ns
		DS	512.54	512.66		
325	fondness of m.	non-DS	452.24	447.08	35.40	.001
		DS	551.70	557.26		
326	goodness	non-DS	498.50	502.63	.05	ns
		DS	501.60	497.12		
327	talkativeness	non-DS	503.42	505.87	0.22	ns
		DS	496.42	493.77		
328	openness	non-DS	525.75	533.81	9.19	.01
		DS	472.20	463.50		
Age		non-DS	193.01	189.50	1.76	ns
		DS	198.04	201.83		

Appendix 16. The covariance analyses with multiple covariates. The six social competence factors and chronological age

Variable		Group	Mean	Adj.mean	F(1,96)	p<
331	self-help	non-DS	510.44	513.45	1.75	ns
		DS	489.14	485.89		
332	communication	non-DS	527.68	530.15	10.52	.01
		DS	470.06	467.39		
333	reliability	non-DS	498.88	499.93	0.0	ns
		DS	501.24	500.11		
334	errand-willingn.	non-DS	501.92	504.25	0.17	ns
		DS	497.90	495.38		
335	play	non-DS	501.90	502.92	0.14	ns
		DS	495.94	494.84		
336	cleanness	non-DS	504.90	511.09	1.54	ns
		DS	494.68	488.00		
Age		non-DS	193.01	189.18	2.99	ns
		DS	198.04	202.18		

Appendix 17. The covariance analyses with multiple covariates. All 23 factors and chronological age

Variable		Group	Mean	Adj.mean	F(1,79)	p<
301	head	non-DS	536.00	561.48	19.13	.001
		DS	461.08	433.56		
302	stockiness	non-DS	474.72	480.06	2.00	
		DS	527.36	521.59		
303	index	non-DS	494.81	505.75	0.11	ns
		DS	505.68	493.86		
304	vertic. height	non-DS	537.09	545.99	10.97	.01
		DS	458.00	448.38		
305	horiz. breadth	non-DS	543.55	565.15	25.76	.001
		DS	452.92	429.59		
311	visual perc.	non-DS	498.42	462.90	6.50	.05
		DS	507.72	546.08		

continued

Appendix 17 (continued)

Variable		Group	Mean	Adj.mean	F(1,79)	p <
312	psychomotor	non-DS	547.72	546.90	12.46	.001
		DS	448.52	449.39		
313	verbal	non-DS	519.07	493.44	0.20	ns
		DS	479.38	507.05		
314	short-term m.	non-DS	509.85	521.03	1.62	ns
		DS	489.28	477.20		
321	evenness	non-DS	491.74	500.37	0.0	ns
		DS	509.00	499.68		
322	boldness	non-DS	498.14	511.82	0.55	ns
		DS	502.02	487.25		
323	emotionalism	non-DS	509.37	514.00	0.83	ns
		DS	489.80	484.79		
324	concentration	non-DS	488.27	507.08	0.32	ns
		DS	512.54	492.22		
325	fondness of m.	non-DS	452.24	466.01	5.13	.05
		DS	551.70	536.82		
326	goodness	non-DS	498.50	497.26	0.02	ns
		DS	501.60	502.93		
327	talkativeness	non-DS	503.42	512.56	0.69	ns
		DS	496.42	486.54		
328	openness	non-DS	525.75	526.82	2.41	ns
		DS	472.20	471.05		
331	self-help	non-DS	510.44	498.85	0.0	ns
		DS	489.14	501.65		
332	communication	non-DS	527.68	526.49	3.34	ns
		DS	470.06	471.34		
333	reliability	non-DS	498.88	501.19	0.0	ns
		DS	501.24	498.75		
334	errand-willingn.	non-DS	501.92	488.96	0.53	ns
		DS	497.90	511.89		
335	play	non-DS	501.90	492.28	0.21	ns
		DS	495.94	506.33		
336	cleanness	non-DS	504.90	499.35	0.0	ns
		DS	494.68	500.67		
Age		non-DS	193.01	187.65	2.01	ns
		DS	198.04	203.83		

Appendix 18. The discriminant analyses with all 23 factors measured and between the groups of sex. RISKP = 50.0.

Tests for equality of means and additional information

Factor		eq. of means	ad. inf.	RISKP
305	horiz. breadth	F(1,102) = 14.79	F(1,124) = 97.04	1.00
304	ver. height	F(2,101) = 14.08	F(2,122) = 36.36	1.00
301	head	F(3.100) = 13.33	F(3,120) = 18.31	1.00
312	psychomotor	F(4,99) = 12.94	F(4,118) = 10.03	1.00
325	fond. of music	F(5,98) = 11.78	F(5,116) = 6.37	1.00
328	openness	F(6,97) = 10.67	F(6,114) = 4.36	.99
324	concentration	F(7,96) = 9.88	F(7,112) = 2.98	.99
335	play	F(8,95) = 9.21	F(8,110) = 2.05	.95
323	emotionalism	F(9,94) = 8.65	F(9,108) = 1.39	.80
313	verbal	F(10,93) = 8.09	F(10,106)= 0.96	.52
332	communication	F(11,92) = 7.68	F(11,104)= 0.60	.17

F-test for equality of covariance matrices

$F(276, \infty) = 1.3525$ $p < .001$

Eigenvalues	%	Chi-square	df	p<	Canonical cor.	RISKP
.91	100.0	63.51	11	.001	.69	50.0

Discrimination function coefficients

301	304	305	312	313	323	324	325	328	332	335
-.56	-.71	-.60	.22	-.49	.18	.17	-.47	-.35	.35	-.25

Correlations between discriminating functions and variables

301	304	305	312	313	323	324	325	328	332	335
-.38	-.47	-.49	.08	-.30	.19	.34	.03	-.38	-.06	-.20

Discriminant scores (RISKP = 0.0)

	mean	SD	$D/\bar{s} = 2.02$
Male	404.62	101.21	
Female	607.05	98.61	

Appendix 19. The discriminant analyses with all 23 factors measured and between the groups of type of care. RISKP = 50.0.

Tests for equality of means and additional information

Factor		eq. of means	ad. inf.	RISKP
333	reliability	F(1,102) = 13.92	F(1,124) = 93.64	1.00
314	short-term m.	F(2,101) = 12.19	F(2,122) = 37.01	1.00
313	verbal	F(3,100) = 11.52	F(3,120) = 19.29	1.00
303	index	F(4,99) = 10.60	F(4,118) = 11.69	1.00
323	emotionalism	F(5,98) = 10.88	F(5,116) = 6.55	1.00
305	horiz. breadth	F(6,97) = 10.38	F(6,114) = 4.08	.99
321	evenness	F(7,96) = 9.70	F(7,112) = 2.69	.98
327	talkativeness	F(8,95) = 9.05	F(8,110) = 1.81	.91
328	openness	F(9,94) = 8.42	F(9,108) = 1.25	.72
304	ver. height	F(10,93) = 7.88	F(10,106)= 0.84	.41

F-test for equality of covariance matrices

$F(276, \infty) = 1.65$ $p < .001$

Eigenvalues	%	Chi-square	df	p<	Canonical cor.	RISKP
.84	100.0	60.15	10	.001	.67	50.0

Discrimination function coefficients

303	304	305	313	314	321	323	327	328	333
.55	-.21	.39	-.72	-.47	-.23	.47	.26	.22	-.39

Correlations between discriminating functions and variables

303	304	305	313	314	321	323	327	328	333
.31	-.21	.12	-.45	-.43	.13	.21	.05	.26	-.49

Discriminant scores (RISKP = 0.0)

	mean	SD	$D/\bar{s}$ = 1.98
Residential care	608.78	101.24	
Open care	410.30	98.96	

Appendix 20. Tests and scales used

Physical growth: Variables 5-24. See chapter 3.1.

Intelligence: Variables 25-34

25. Peg Board. A modification of the Stromberg Dexterity Test. Stromberg, E. L. (1960) Stromberg Dexterity Test. Test Catalog. New York: The Psychological Corporation, p. 16. Modification: Without color discriminations.
    Time: 60 seconds
    Scoring: number of pegs on the board at the end of 60 s. If needed, prorate the score.
26. Bead Stringing. 18 beads of the sort supplied with the S-B test kit. The test is the same as in Meyers et al. 1962, p. 23.
27. Raven. (1956) Coloured Progressive Matrices, Set A and Ab. London: George C. Harrap.
28. Visual short-term memory test. Constructed by the present author according to the model in the study of Atkinson & Hansen (1964) Short-term memory with young children. Psychon. Sci., 1, p. 255-256.
    Materials: In 11 items 49 coloured pictures of familiar objects which are shown one at a time to the subject. Each card is shown for two seconds. For each item there is a cue card. The subject is asked to turn up the card which he thought matched the cue card. When incorrect, the subject continues to turn up cards until he locates the correct one.
    Time: untimed
    Scoring: 3 points when the cue card was correctly located on the first trial, with 2 points when correctly located on the second trial and with 1 point when correctly located on the third trial and with zero when more than three trials were needed.
29. Van Alstyne Picture Vocabulary Test. Van Alstyne, D. (1961) Harcourt, Brace & World.
30. Peabody Picture Vocabulary Test. Dunn, L. M. (1959) Peabody Picture Vocabulary Test, Form B. American Guidance Service.
31. Block Design modification. Wechsler, D. (1967) Wechsler Preschool and Primary Scale of Intelligence. Manual. New York: The psychological Corporation, p. 73.
    Modification: Designs 1-10 are demonstrated on both trials.

continued

Appendix 20 (continued)

32. Auditory-Vocal Sequencing Test of ITPA. McCarthy, J. J. & Kirk, S. A. (1961) Illinois Test of Psycholinguistic Abilities. Experimental edition. Examiners Manual. Institute for Research on Exceptional Children, University of Illinois, Urbana, Illinois, p. 50.
33. Identical Pictures. Thurstone & Thurstone (1954) Primary Mental abilities. Ages 5-7. Fourth Edition. See Meyers et al. 1962, p. 24.
34. Pacific Pattern Copying. Same as in Meyers et al. 1962, p. 27

Personality traits: Variables 35-48

Variable				
35.	Cheerful, glad	3+2+1	0-1-2-3	bad tempered, depressed
36.	Social, companionable	"	"	gets on alone, solitary
37.	Docile, obedient	"	"	disobedient, tricky, independent
38.	Does not become angry, irritated	"	"	easily angry, irritated
39.	Does not use violence against anybody	"	"	sometimes violent
40.	Non-destructive	"	"	destructive
41.	Good to everybody, does not hurt others	"	"	evil, mischievous to others
42.	Even-tempered, placid	"	"	restless, impulsive
43.	Loud, noisy	"	"	quiet
44.	Talkative	"	"	uncommunicative
45.	Careful	"	"	careless
46.	Brave	"	"	timid
47.	Fast	"	"	slow
48.	Self-confident	"	"	shy
49.	Can concentrate	"	"	unable to concentrate
50.	Independent, original	"	"	non-independent, dependent
51.	Kind	"	"	rude
52.	Peaceful	"	"	quarrelsome
53.	Spontaneous	"	"	reserved
54.	Adjusts well to the ways and customs of the institution	"	"	does not adjust well to the ways and customs of the institution

continued

Appendix 20 (continued)

55.	More interested in people	3+2+1	0-1-2-3	more interested in things
56.	Even, good-natured, patient	"	"	easily gets excited, angry
57.	Industrious, enterprising	"	"	unwilling, lazy
58.	Bold, brave	"	"	cautious, uncertain
59.	Slight changes of mood	"	"	marked changes of mood
60.	Tough, persistent	"	"	gives up, gets tired
61.	Shows sexual activity	"	"	does not show sexual activity
62.	Fond of nurses and peers	"	"	is not fond of nurses and peers
63.	Fond of music and rhythm	"	"	not particularly fond of music and rhythm
64.	Shows tendency to imitate with expressions and gestures	"	"	does not show tendency to imitate with expressions and gestures
65.	Does not quarrel easily with peers	"	"	quarrels easily with peers
66.	Is satisfied with everything around	"	"	is not satisfied with everything around
67.	It is easy to get along with him	"	"	it is not easy to get along with him
68.	Does not mind criticism	"	"	is offended by criticism
69.	Does not contradict nurses	"	"	contradicts nurses
70.	Not noisy when bad-tempered	"	"	noisy when bad-tempered
71.	Is not rude to the nurses	"	"	is sometimes rude to the nurses
72.	Talks willingly with others	"	"	does not talk willingly with others
73.	Self-confident, self-sufficient	"	"	uncertain, shy, lacking self-esteem
74.	Initiative in play	"	"	withdrawn in play
75.	Boastful	"	"	modest
76.	Participates willingly in vigorous games	"	"	does not participate in vigorous games
77.	Can be trusted to behave according to instructions	"	"	cannot be trusted to behave according to instructions
78.	Is willing to finish tasks	"	"	cannot finish tasks

continued

Appendix 20 (continued)

79.	Helpful if needed	3+2+1	0-1-2-3	unable to be helpful if needed
80.	Gets on easily with peers	"	"	does not get easily with peers
81.	Is interested in new tasks or work	"	"	is not interested in new tasks or work
82.	Strives for popularity or sympathy	"	"	does not strive for popularity or sympathy
83.	Is kind to his juniors, does not bully them	"	"	is unkind to his juniors, bullies them
84.	If discriminated, does not mind	"	"	is sorry if discriminated

Social competence: Variables 85-128

The Cain-Levine Social Competence Scale. Cain, L. F., Levine, S. & Elzey, F. F. (1963) Manual for the Cain-Levine Social Competency Scale. Palo Alto: Consulting Psychologist Press.

Appendix 21. The reliabilities of the intelligence tests, of the personality rating scale and of the Cain-Levine Social Competency Scale used

Tests and scales	Reliability coefficients	h^2
Block Design	.82 SH	
Identical Pictures	.59 RT	.925
Pacific Pattern Copying	.91 K-R, .90 SH	.623
Raven	.76-.91 SH, RT	.818
Auditory-Vocal Sequencing Test	.80 SH	
Visual short-term memory test	.478 SH	
Peg Board	.69 RT	
Bead Stringing		.672
Van Alstyne Picture Vocabulary Test	.71 SH	
Peabody Picture Vocabulary Test	.67 PT	
The personality trait rating scale	.894 SH	
The Cain-Levine Social Competency Scale	.94 RT	

Reliability coefficients: RT = re-test
SH = split-half
PT = parallel test
K-R = Kuder-Richardson

h^2 = communalities in factor analyses with retarded subjects according to Meyers et al. 1962, 1964.