A STUDY OF SOME OF THE FACTORS AFFECTING THE AMOUNT
OF GROSS BODILY MOVEMENT IN A GROUP OF NURSERY
SCHOOL CHILDREN

by

RUTH MARIAN KELL

B. S., Kansas State Agricultural College, 1925

———————

A THESIS

submitted in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

KANSAS STATE AGRICULTURAL COLLEGE

1927

TABLE OF CONTENTS

INTRODUCTION

Among the first questions which the skeptical layman asks about nursery schools is always one connoting a fear that the child so early introduced into a relatively complex social environment such as the nursery school affords is in danger of prematuration and over-pressure. If as the layman fears there are some children who are over-stimulated by the usual nursery school program, accomplishing the necessary adaptation only at the cost of considerable nervous energy with consequent physical and mental detriment to themselves, it is important that we recognize this type of child in order to adapt the nursery school program to his particular needs. Recognition is the more urgent because it lies so largely in the power of the nursery school teacher to regulate the stimulation level of the school by modification of the play materials and games offered, the proportion of the day spent in rest and sleep, and the soothing or activating influence of her own personality.

Because scientific knowledge of individual differences in reaction to stimuli is so meager the nursery school teacher has had no recourse but to follow the layman in regarding as over-stimulated the child who displays such symp-

toms as flitting from one project to another, an unusual a-
mount of apparently purposeless and excited activity, marked
lack of concentration, continuous chattering and nervous
laughter, and restlessness. His opposite, the child who is
content to sit passively with the piece of play material
given him until he is given another seems to have concerned
us less, probably because he is less trouble. It would be
consistent to consider him "under"stimulated". By popular
consent we call the former child "nervous" or "over-active"
and the latter "quiet" or "under-active", implying that the
normal or most desirable state lies somewhere between.

As a matter of fact we know so little about the attri-
butes of physical activity, as such, that we cannot say
what amount is most desirable or even that it is a trait
which we should attempt to modify. Recognizing this defi-
ciency in our knowledge the conscientious nursery school
teacher must question whether the "over-active" child is so
because he is being over-stimulated or because it is the de-
gree of activity normal to him, and the reverse. The ques-
tion must go unanswered until we have through investigation
established the relationships between physical activity
(gross bodily movement) and other physical and mental traits
and social influences. A thorough search of the literature
reveals practically nothing about activity in this sense ex-

cept meager speculation as to its significance in the
fields of child psychology, nutrition, and anthropometry.

PURPOSE OF THE STUDY

It has been pointed out that the common and most ob-
vious component of the usually accepted symptoms of over-
stimulation in the young child is the high output of physi-
cal activity in the sense of gross bodily movement, and the
reverse.

The following study was purely exploratory for the two-
fold purpose of establishing some of the factors affecting
or affected by gross bodily movement, and opening new lines
of inquiry. The specific problem was to discover the rela-
tionship, if any, between the amount of gross bodily move-
ment as measured by pedometers in a group of nursery school
children, and their chronological age, mental age, physical
age, carpal age, speech quantity, amount of diurnal sleep,
leg length in percentage of the total recumbent length, gen-
eral nutritional condition, prevailing tendency to intro-
version or extroversion, and sex. These factors were chosen
on the basis of availability of data in records already ex-
tant or possible to gather, and diversity in the hope of
leading to far flung avenues of approach to further study.

ACKNOWLEDGMENTS

CONDITIONS OF THE STUDY

The study was made in the Merrill-Palmer School, Detroit, Michigan. The nursery school has an enrollment of sixty-five children between the ages of eighteen and sixty months, and is divided into two units, the younger and the older children. Only normal children are admitted. The

nursery school day is from nine o'clock in the morning to
three-thirty in the afternoon. Observations for the study
were made only during the hours from nine to twelve as the
afternoon program consists of luncheon and nap. The usual
daily morning program is as follows:

Group I	Group II
(Younger Children)	(Older Children)
Indoor work period	Orange juice
Morning circle	Indoor work period
Rhythms Singing Conversation Stories	Cloakroom
Orange juice	Outdoor play period
Cloak room	Cloakroom, toilet, washing
Outdoor play period	Morning circle
Cloakroom, toilet, washing	Rhythms Singing Conversation Stories

SUBJECTS OF THE STUDY

Basis for Selection

The subjects of the study were chosen on the basis of
chronological age alone. All the children enrolled in
school who on February 1, 1926 fell within the age limits of
thirty-four to thirty-seven months were placed in Group I

and all those between fifty-one to fifty-five months in
Group II. Some were later dropped because of prolonged ab-
sence. The final grouping was composed of eighteen chil-
dren, six girls and three boys in Group I and five girls and
four boys in Group II. The difference in age between the
groups was fourteen months. Hereafter the individual sub-
jects will be referred to as A, B, C. D, E, F, G, H, and I
with the Roman numerals I and II to designate in which group
they belong; thus, A-I refers to subject A in Group I, and
B-II to subject B in Group II.

Home Background

Table I shows the home social background of the sub-
jects. Data concerning parents, siblings and other adults
in the home were collected from Merrill-Palmer School rec-
ords, the remainder from questionnaires filled out by the
parents. Analysis reveals that of the thirty-six parents,
twenty-nine have had a college or other specialized educa-
tion. In twelve of the eighteen homes the mother is the
housekeeper and in eleven there is a servant. The outstand-
ing fact is that most of the subjects have a better than
average social background.

The average number of siblings is about 1.5 although
in seven homes the subject is the only child. The average

TABLE I.

The home social background of the subjects

Subject	Mother Age Jan 1 1926	Mother Occupation	Mother Education	Father Age Jan 1 1926	Father Occupation	Father Education	Siblings B-brother, S-sister, Age Jan 1 1926, yrs.	Other adults in home M-maid, G-grandparent, R-relatives	Playmates other than siblings B - Boy, G - Girl, Age in yrs.	Time spent with adults Avge. hrs. per day	Time spent with siblings Avge. hrs. per day	Time spent with playmates Avge. hrs. per day	Time spent alone Avge. hrs. per day
A- I	42	Home	College Normal	48	Court reporter	College Normal	B-14,S-13	M, R, R	Occasionally, B-4	6	4	Not regularly	3
B- I	30	Home	Health education school	48	education	school	S- 4,3,1	M.	G-3½	2-3	2	1	-
C- I	35	Home	High Sch.	35	M.D.	College	B-7,S-5,3	M.	B-8,G-5,6	5	5	1-2	-
D- I	35	Home	High Sch.	35	M.D.	College	B-7,3 S-5	M.	B-8,G-5,6	5	5	1-2	-
E- I	31	Nurse	Nurs. Normal	39	Printer Health	College Normal	- - -	- - -	G-5, 3	4-6	-	½	(Always)
F- I	30	Home	School	48	Education	school	S-4, 3,1	M.	G-3½	2-3	2	1	-
G- I	35	Business	Business	Dead	Business	Business	- - -	- - -	- - -	5-6	-	-	1-2
H- I	34	Nurse	College Normal	34	Athletics	College	- - -	M.	- - -	4½	-	-	2
I- I	28	Salesman	school	Dead	- -	College	- - -	- - -	B-2,3,G-3	6-7	-	1	About all time

TABLE I. Continued

A-	II	Dead	--	High sch.	34	Salesman	College	B-9	--	--	-	--	--	--
B-	II	27	Home	Grade	32	Salesman	College	---	--	B-2,6,12,12,G-2,5,11,12,13				
C-	II	34	Home	High sch.	31	Insurance	High sch.	B-1	M.	B-2,G-3½	2	2	2	-
D-	II	32	Home	Music	40	Real Est.	High sch.	B-6,S-1	M,M,M	B-6,G-6	3-5	6	2	-
E-	II	32	Home	College	38	Surgeon	College	S-7	M,M,G,G	B-3,G-4 B-5,8	3-4	3-4	2	-
F-	II	29	Home	College	35	Architect	Art	B-2	--	G-8,8	3	½	2	1
G-	II	30	Home	Business	41		College	B-14,13,9,6	--	B-2½,G-6 G-5,G-5	3	All time brother6	2	Very little
H-	II	32	Home	College	35	Dentist	College	S-2	--	G-6, B-7 B-7, B-9	5	5	2	-
I-	II	30	Salesman	College	43	Engineer	College	---	M, G	G-4, G-6	6	-	2	-

number of hours out os school spent with siblings or other
playmates is 2.4. Five of the seven"only" children spend
some time out of school with playmates, leaving only two
children of the eighteen who may be said to be subjected to
an artificial home atmosphere favoring sedentary habits due
to lack of playmates.

METHOD OF OBSERVATION

Measurement of Gross Bodily Movement

Pedometers. For measuring the amount of gross bodily
movement pedometers were used. At the beginning of the
study they were regulated to register alike as follows:
Two pedometers were held tightly in the hand, back to back,
the stems in identical positions. They were then shaken
vertically in such a way as to secure the fullest possible
swing of the pendulums, and the regulators gradually adjust-
ed until both pedometers registered 220 yards at the same
time in three out of four trials. The other pedometers were
standardized by the same method to this pair. Once a week
during the course of the experiment the pedometers were
tested for standardization by the above method. As a matter
of fact after the preliminary adjustment they needed very
little further regulation.

Since the study was concerned with relative rather than absolute distance no attempt was made to adjust the pedometer to the step of the subject.

<u>Establishment of a Technique.</u> The technique presented a two-fold problem, first to attach the pedometer to the subject in such a way as to be least noticeable both to him and to his playmates and at the same time to allow it free movement, and second to divide the nursery school morning into convenient observation periods during which readings could be taken with least confusion to the school regime.

The first aspect of the problem was met as follows: A tape was knotted through the ring of the pedometer so that the pedometer swung freely when the tape was tied around the waist of the subject. The first trial was made with the tape outside the clothing, the pedometer hanging in front. This location proved unsatisfactory since the dangling pedometer intruded more or less constantly upon the child's attention. When the pedometer hung in the back it was played with by the other children. It was suggested that an accurate record might be obtained by tieing the pedometer around the knee of the subject but this method was discarded as too hampering. The object was finally attained with the boys by slipping the pedometer inside the loose belt at the back of the trousers, and with the girls by tie-

ing the tape under the dress the pedometer in the back.

The second aspect of the problem required less experimentation. The nursery school morning was found to fall into three convenient periods each about an hour in length. It was found advisable to read the pedometers three times during the morning in order to avoid losing the entire morning's record through some unforeseen abnormality in the program.

Final Technique. The interest of all the children was enlisted by the nursery school teacher, who introduced a pedometer into the morning circle explaining that it was a watch which measured distance instead of time and that it was to be worn, not played with.

The approach to the subject varied with the individual and the circumstances in which he was found. In general it consisted of some such remark as "I'm going to give you a watch to wear this morning" in a tone implying privilege. If the child hesitated he was allowed to handle it while being informed that it was a watch which measured how far he went. After his curiosity was satisfied the observer suggested, "It is worn around the waist like this", at the same time tieing it around the child's waist. Children wearing it for the first time were cautioned by saying impressively after gaining their full attention, "Now you will remember

that it is to be worn, not played with. It is just to be worn, like that."

If the child refused the pedometer he was not urged but opportunities were taken to call his attention to other children who were asking for or wearing them. A little of this form of social pressure was sufficient.

The tape was tied around the waist out of sight the pedometer freely pendant in the back. Readings were taken after each of the three morning periods the pedometers being set back to zero after each reading. The length in minutes of the period was noted with the distance in yards so that at the end of the study period the average daily rate in yards per minute could be obtained for each subject.

Observations were made only on those days when the subject was judged physically fit by the school nurse, the nursery school teacher and the observer, and when the nursery school program was normal.

Calculation of Chronological Age

Chronological ages are given in months as calculated from the birth date of the child to the mid-date of the observation period.

Calculation of Mental Age

Mental ages are given in months as calculated from mental measurements made on the Stanford-Binet Scale by experienced testers. Mental ages for subjects A-I and D-I who would not respond to the Stanford-Binet Test were calculated from their Merrill-Palmer Performance Test scores.

Calculation of Physical Age

Physical ages are given in months and were calculated as follows: The standing height of each subject at the chronological age cited for him in this study was obtained from the school records. This height was then located on the appropriate table in Children's Bureau Publication, Number 84 (1923) and the age corresponding to that height on the table was used as his physical age.

Calculation of Carpal Age

Carpal ages are given in months and are based on X-ray pictures of the subjects' wrists taken during the observation period and read by the physician in charge according to the method of Pryor (1915) and Rotch (1910). Carpal ages for subjects A-II, B-II, and E-II who were absent when the

X-rays were taken were calculated from the readings of a
year previous, according to the following procedure: The
carpal age of the year previous (May, 1925) was divided by
the corresponding chronological age, and the quotient mul-
tiplied by the chronological age cited for the subject in
this study.

Measurement of the Quantity of Speech

Speech quantity for each subject in average number of
words spoken per minute is based on data collected by Miss
Mattson (1926) during the observation period of this study
and under the same conditions which governed this study.
Records of every word spoken by each subject were taken
verbatim for three consecutive hours on three different
mornings. Because of extended absences averages for sub-
jects A-II and B-II are based on three hours observation
only and for subject C-I on six hours.

Measurement of Amount of Sleep

Amount of sleep in average number of minutes of sleep
during the school nap period is based on data collected by
Miss Flemming (1926) during the observation period of this
study.

Measurement of Leg Length

Leg length was calculated by subtracting the stem length from the total recumbent length of the subject at the chronological age cited for him in this study, and is here expressed as percentage of total recumbent length.

Rating of General Nutritional Condition

In order to determine the general nutritional condition of the subjects they were ranked by seven competent raters according to the following instruction:

PLEASE RANK THE FOLLOWING CHILDREN

ACCORDING TO THEIR GENERAL NUTRITIONAL CONDITION

1. Place the figure (1) in the space provided beside the name of the child who in your estimation ranks highest in the group.

2. Place (18) in the space provided beside the name of the child whose general nutritional condition you consider poorest in this group.

3. Choose from the group five (5) that you consider nearest average and number them in the spaces provided beside their names, (7), (8), (9), (10), and (11). If you find it difficult to make a decision between two children force a decision. Give each child one number.

4. Number the remaining children's names according to the rank that you think they should have in this group of eighteen.

5. Each of the eighteen names should be numbered. Please check your numbering to be sure that you have used no number twice.

The raters were individuals associated with the nutritional and medical staff of the Merrill-Palmer School. It is probable that their viewpoints varied somewhat with their experience and backgound. However, all were thoroughly familiar with the nutritional and physical histories of the subjects and experienced in physical examinations and in judging the nutritional state of children. From their ratings the average rank of each child on the scale of eighteen was determined, the child in the best nutritional condition being given the rank of one and the child in poorest condition the rank of eighteen.

Ratings of Introversion and Extroversion

According to Marston (1925) the terms introversion and extroversion describe the character phase of personality with reference to the absence or presence of overt expressions of mental functions. Emotional extroversion is defined behavioristically as the expression of emotionally aroused energy through skeletal channels, emotional introversion as the dissipation of emotionally aroused energy within the organism. The stimuli that most clearly differentiate introversion and extroversion as type tendencies are social. The terms were first used by Jung (1919) although the types had been previously outlined by others. Since

Jung's treatise the introvert and extrovert as personality types have been elaborated on by numerous writers, most notably Hinkle (1922), Tansley (1921), Nicoll (1917), McDougall (1921), Kempf (1921), and Freyd (1924).

Experimental work on the emotional traits of young children has been very limited. The most noteworthy is that of Chassel (1924) with ratings of kindergarten children on such traits as habits of work, cooperation, and responsibility; Gates (1923) with tests of social perception in children as young as three years; and Marston (1925) with ratings of children two to six years old on traits of introversion and extroversion and measurement in behavioristic terms of their introverted or extroverted reactions to situations testing social resistance, compliance, interest, and self assertion.

In order to ascertain the emotional tendencies of the subjects of this study, Marston's Introversion-Extroversion Rating Scale was used. A brief summary of Marston's description of his scale follows. The scale lists twenty traits of introversion, each paired against the opposing trait of extroversion. The traits describe manifestations of introversion and extroversion largely in terms of disposition of energy aroused by emotional stimulation especially as aroused by social influences. Three groups of traits may be roughly outlined: traits 1, 2, 3, 4, 8, 9, 11, 13, 18,

and 19 describing social or self attitudes, traits 5, 6, 7, 14, 15, 16, and 17 describing energy qualities, and traits 10, 12, and 20 describing characteristic emotional tendencies. The scale possesses the advantage of freeing the rater from the difficulty of making direct quantitative estimates by narrowing decision to two alternatives. Thus subjects judged slightly off average are not piled up on the median score as is the case with most rating scales but are thrown to the sides securing a more sharply defined differentiation.

The subjects of Marston's investigation were rated on this scale by an average of slightly more than three raters per subject. By comparing the average profiles of the seven subjects rated most introverted with those of the seven rated most extroverted Marston found the scale to be in general highly diagnostic. By dividing the twenty traits into two series of ten each and correlating the partial ratings in these two series he found the correlation between the two halves to be .95 and .91 for the boys and the girls respectively. As thus determined the reliability of the rating scale is fairly high.

The rating scale is here reproduced with the traits of extroversion starred.

NAME OF RATER...DATE....................

INSTRUCTIONS:

1. A thorough acquaintanceship with the subject is necessary.

2. Consult no one in forming your judgments; what is desired is your estimate of the subject uninfluenced by what others may think of him.

3. Keep the subject in complete ignorance of the fact that he is being rated.

4. In rating the subject on a particular trait, disregard every other trait but that one. Many ratings are worthless because the rater has been influenced by a general impression he has formed of the subject, favorable or unfavorable.

5. In the following list of paired contrasting traits, mark with TWO PLUSES that characteristic of each pair which correctly describes the person you are judging. If neither statement of the pair correctly describes him, mark with ONE PLUS the trait toward which he inclines. If you cannot decide that either statement of the pair is more applicable than the other, mark each with a MINUS.

TRAITS

-1-

( ) Is self-conscious; easily embarrassed; timid or 'bashful'.

( )*Is self-composed, seldom shows signs of embarrassment, perhaps is forward or 'bold'.

-2-

( ) Avoids talking before a group; when obliged to talk before a group, finds it difficult.

( )*Eager to express himself before a group; likes to be heard.

-3-

( )*Prefers group activities, work or play; not easily satisfied with individual projects.

( ) Prefers to work and play alone; tends to avoid group activities

-4-

( )*Insistent upon the acceptance of his ideas and plans; argumentative and persuasive.

( ) Not insistent upon the acceptance of his ideas and plans; agrees readily with others' wishes; compliant and yielding.

-5-

( ) Inclines toward activities requiring care; good in details; 'careful'.

( )*Prefers activities demanding pep and energy, but not exacting care; perhaps is neglectful of details.

( ) Deliberative; slow in making
decisions; perhaps even on minor
matters, overly cautious.

-6-

( )*Impetuous and impulsive; may
plunge into situations where
forethought would have de-
terred him.

-7-

( )*Keenly alive to environment,
physical and social; live
curiosity.

( ) Rather indifferent to external
events; tends to detachment
from environment.

-8-

( )*Self-confident and self-reliant;
tends to take success for granted;
strong initiative; prefers to lead.

( ) Lacking in self-confidence and
initiative; a follower.

-9-

( ) Reserved and distant except to
intimate friends; does not form
acquaintanceships readily.

( )*Hearty and cordial even to
strangers; forms acquaintance-
ships very easily.

-10-

( ) Tends to depression; frequently
gloomy or moody.

( )*Tends to elation of spirits;
seldom gloomy or moody.

-11-

( )*Rather insensitive and indiffer-
ent to others' opinions; indifferent.

( ) Very sensitive and easily
'hurt'; reacts strongly to
praise or blame.

-12-

( )*Not given to worry or anxiety;
care free.

( ) Worries over possible misfor-
tunes; 'crosses bridges before
coming to them'.

( ) Shows preference for a narrow range of intimate friends, and tends to exclude others from his association.

( ) Slow in movement; deliberative or perhaps indecisive; energy output moderate or deficient.

( ) Shrinks from making new adjustments; prefers the habitual to the stress of reorganization required by the new.

( )*Turns from one activity to another in rapid succession; slight perseveration tendency.

( ) Emotions not freely or spontaneously expressed.

( ) Secretive; seclusive and 'shut-in'; not inclined to talk unless spoken to.

-13-

( )*Seeks broad range of friendships; not selective or exclusive in games, etc.

-14-

( )*Quick and decisive in movement; pronounced or excessive energy output.

-15-

( )*Adaptable to new situations; makes adjustments readily; welcomes change.

-16-

( ) Marked perseveration tendency; does not abandon an activity readily regardless of success.

-17-

( )*Emotions such as sympathy, delight, sorrow, anger, jealousy, etc., readily expressed.

-18-

( )*Frank; talkative and sociable; does not stand on ceremony.

( )*Makes the best appearance possible; inclined to 'bluff' or 'show off'; perhaps conceited.

-19-

( ) Often represents himself at a disadvantage; modest and unassuming; under-estimates his own abilities.

-20-

( ) Does not pass quickly from elation to depression; constancy of mood.

( )*Frequent fluctuations of mood; tends to frequent alternations of elation and depression.

In this study each subject was rated by fourteen raters
all having had previous rating experience and thoroughly fa-
miliar with the subjects having been in daily contact with
them for periods of time varying from five to twenty-two
months. Seven of the raters were on the teaching staff of
the Merrill-Palmer School and seven were graduate students.
About half were unfamiliar with the Marston Introversion-
Extroversion Rating Scale and none knew in what connection
it was to be used.

Although the scale was designed so that the rater
thinks of the traits largely in qualitative terms his judg-
ments are scored quantitatively as points of extroversion
as follows:

$$1 = \text{\ding{}} \text{\ding{}} \quad \text{introvert trait}$$
$$2 = \text{\ding{}} \quad\quad \text{introvert trait}$$
$$3 = - \quad - \text{introvert trait and} - \text{extrovert}$$
$$\quad\quad\quad \text{trait}$$
$$4 = \text{\ding{}} \quad\quad \text{extrovert trait}$$
$$5 = \text{\ding{}} \text{\ding{}} \quad \text{extrovert trait}$$

By tabulating and averaging according to score the
fourteen judgments on each trait the average score on each
trait for each subject was found and also the total average
score for each subject.

RESULTS OF THE STUDY

The results of the study are presented in the following series of graphs which depict some of the relationships between amount of physical activity, meaning gross bodily movement (shown in black ink), chronological age (green), mental age (yellow), physical age (violet), speech quantity (scarlet), sleep quantity (vermillion), leg length in percentage of recumbent length (green), general nutritional condition (brown), and prevailing tendency to introversion or extroversion (blue and violet), and in Table II which shows sex differences. In each graph the data for Group I are represented by broken lines and for Group II by solid lines. The least active child in each group is called A, and so on to the most active who is called I.

The large number of measurements and amount of data gathered for each individual case made it necessary to select a reasonably small number of cases. To secure as wide differences as possible all the children in the school included in two age levels were used as subjects in this study. This means that only one factor, that of chronological age, was considered in selecting the subjects. All other bases of selection were deliberately avoided.

Analysis of Figure 1

Although Group I is on the average more active than
Group II the extremes of the two groups approach each other.
There is more individual variation in Group I, both the most
and the least active of the eighteen subjects being found in
this Group. The fact that in Group I the most active child
is the oldest while in Group II the most active children are
the youngest suggests that there may be during the age peri-
od between the two groups (thirty-nine to fifty-two months)
a period of heightened activity. A possible explanation is
pointed out in the analysis of Figure 4. However, this re-
lationship may be accidental due to the small number of ca-
ses.

There is probably less variation in physical age among
the individuals of Group I than among those of Group II per-
haps because the former have been subjected for a shorter
time to the influences, such as nutrition, living conditions,
exercise, and diseases, which affect growth favorably or un-
favorably. Further evidence for this interpretation will be
noted in Group I in which the physical age more closely ap-
proaches the chronological age than in Group II. Still fur-
ther evidence appears in Figure 4 where in Group II a close
relationship between physical age and general nutritional

Figure 1

Carpal,physical,mental and chronological ages in months	Activity in avge.number of yds. per min.
76	48.1
74	47.0
72	45.9
70	44.8
68	43.7
66	42.6
64	41.5
62	40.4
60	39.3
58	38.2
56	37.1
54	36.0
52	34.9
50	33.8
48	32.7
46	31.6
44	30.5
42	29.4
40	28.3
38	27.2
36	26.1
34	25.0
32	23.9
30	22.8
28	21.7
26	20.6
24	19.5
22	18.4
20	17.3
18	16.2

Subjects: A B C D E F G H I

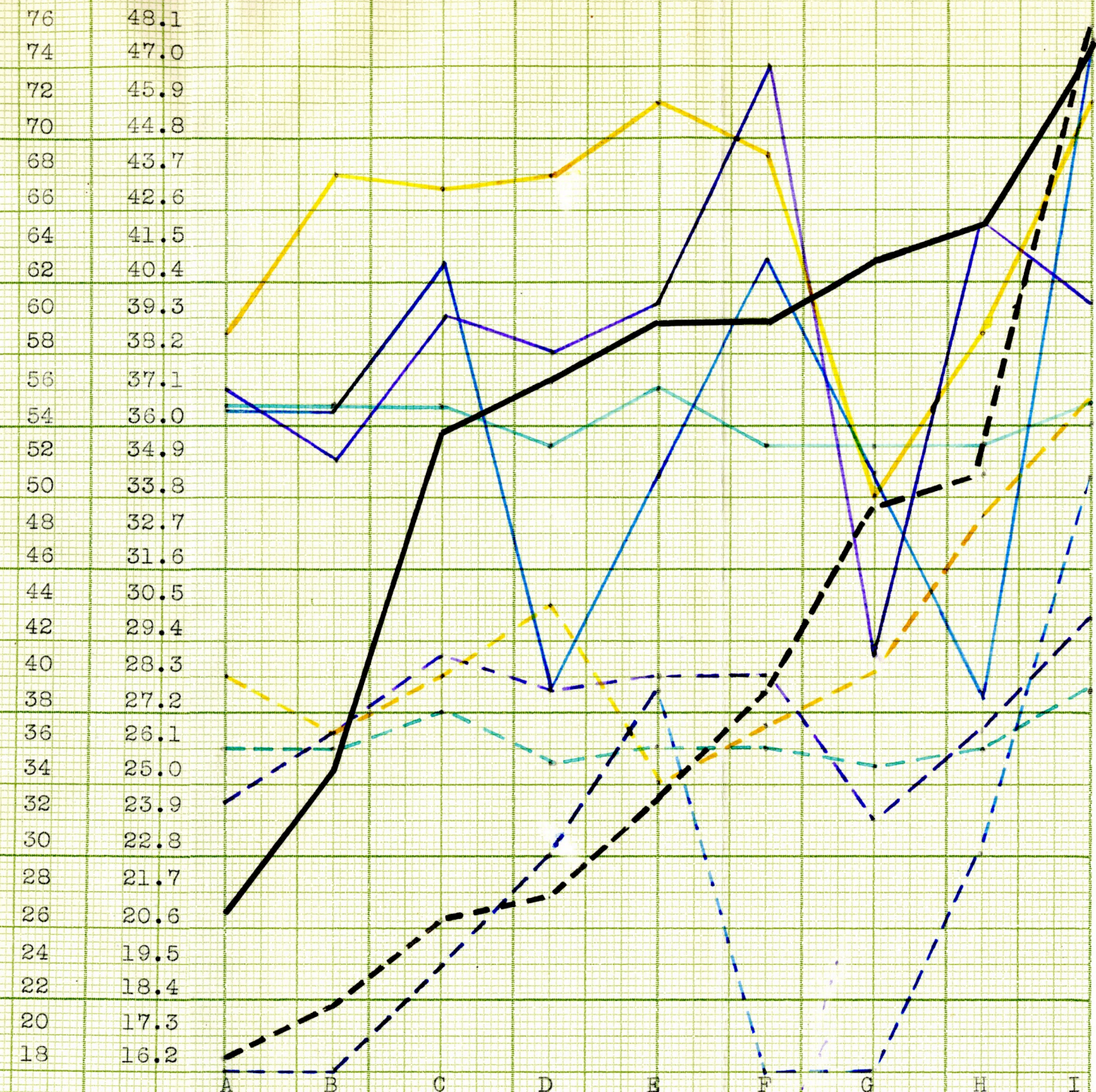Legend:
- Activity in avge. number of yds. per min., Group I
- Activity in avge. number of yds. per min., Group II
- Carpal age in months, Group I
- Carpal age in months, Group II
- Physical age in months, Group I
- Physical age in months, Group II
- Mental age in months, Group I
- Mental age in months, Group II
- Chronological age in months, Group I
- Chronological age in months, Group II

condition is suggested.

The similarity between the physical age and the mental age curves in both groups bears out Terman's (1925) observation that a positive relationship exists between tallness and brightness.

There is little indication of a relationship between physical age and activity or between carpal or mental ages and activity.

In only two cases, E-I and G-II, does the mental age fall below the chronological age. In general Group II has much the higher mental age, proportionately, a fact which may be due to the greater unreliability of mental tests for children of the younger age level or may point to a real difference in the relative intelligence of the groups.

In each group there is an enormous range of carpal ages, eighteen to fifty-one months in Group I and thirty-nine to seventy-five months in Group II with little suggestion of relationship to any other trait except physical age.

Analysis of Figure 2

In Group I there is a positive relationship between quantity of speech and amount of activity. In Group II all subjects except A-II, B-II, a d C-II show a marked positive tendency. As has been mentioned the observation period for

Speech in avge. number of words per min.	Activity in avge. number of yds. per min.									
14.5	48.1
14.0	47.0
13.5	45.9
13.0	44.8
12.5	43.7
12.0	42.6
11.5	41.5
11.0	40.4
10.5	39.3
10.0	38.2
9.5	37.1
9.0	36.0
8.5	34.9
8.0	33.8
7.5	32.7
7.0	31.6
6.5	30.5
6.0	29.4
5.5	28.3
5.0	27.2
4.5	26.1
4.0	25.0
3.5	23.9
3.0	22.8
2.5	21.7
2.0	20.6
1.5	19.5
1.0	18.4
0.5	17.3
0.0	16.2

Subjects: A B C D E F G H I

Figure 2

- - - Activity in avge. number of yds. per min., Group I
——— Activity in avge. number of yds. per min., Group II
- - - Speech in avge. number of words per min., Group I
——— Speech in avge. number of words per min., Group II

speech was comparatively short in the case of A-II and B-II
due to their prolonged absence from school. The children
of Group II are more talkative than those of Group I indi-
cating an increase in amount of speech with increasing chro-
nological age.

Analysis of Figure 3

Group I sleeps longer during the school nap period than
does Group II, bearing out the commonly accepted theory that
younger children need more sleep than older. There is an
inverse relationship between amount of activity and amount
of diurnal sleep, Group I being less active but sleeping
longer than Group II.

Analysis of Figure 4

The curves representing leg length tend to converge
toward the right, i. e. the more active children of Group I
have about the same leg length ratio (approximately 42%) as
the more active children of Group II while the less active
differ markedly (39% to 45%). The similarity among the more
active suggests the possibility of a leg length ratio opti-
mum for gross bodily activity. Children whose leg length is
approximately 42% of their total recumbent length may be
better "balanced" because of the location of the center of

85.5	48.1
83.0	47.0
80.5	45.9
78.0	44.8
75.5	43.7
73.0	42.6
70.5	41.5
68.0	40.4
65.5	39.3
63.0	38.2
60.5	37.1
58.0	36.0
55.5	34.9
53.0	33.8
50.5	32.7
48.0	31.6
45.5	30.5
43.0	29.4
40.5	28.3
38.0	27.2
35.5	26.1
33.0	25.0
30.5	23.9
28.0	22.8
25.5	21.7
23.0	20.6
20.5	19.5
18.0	18.4
15.5	17.3
13.0	16.2

Subjects: A B C D E F G H I

Sleep in avge. number of mins. during school nap
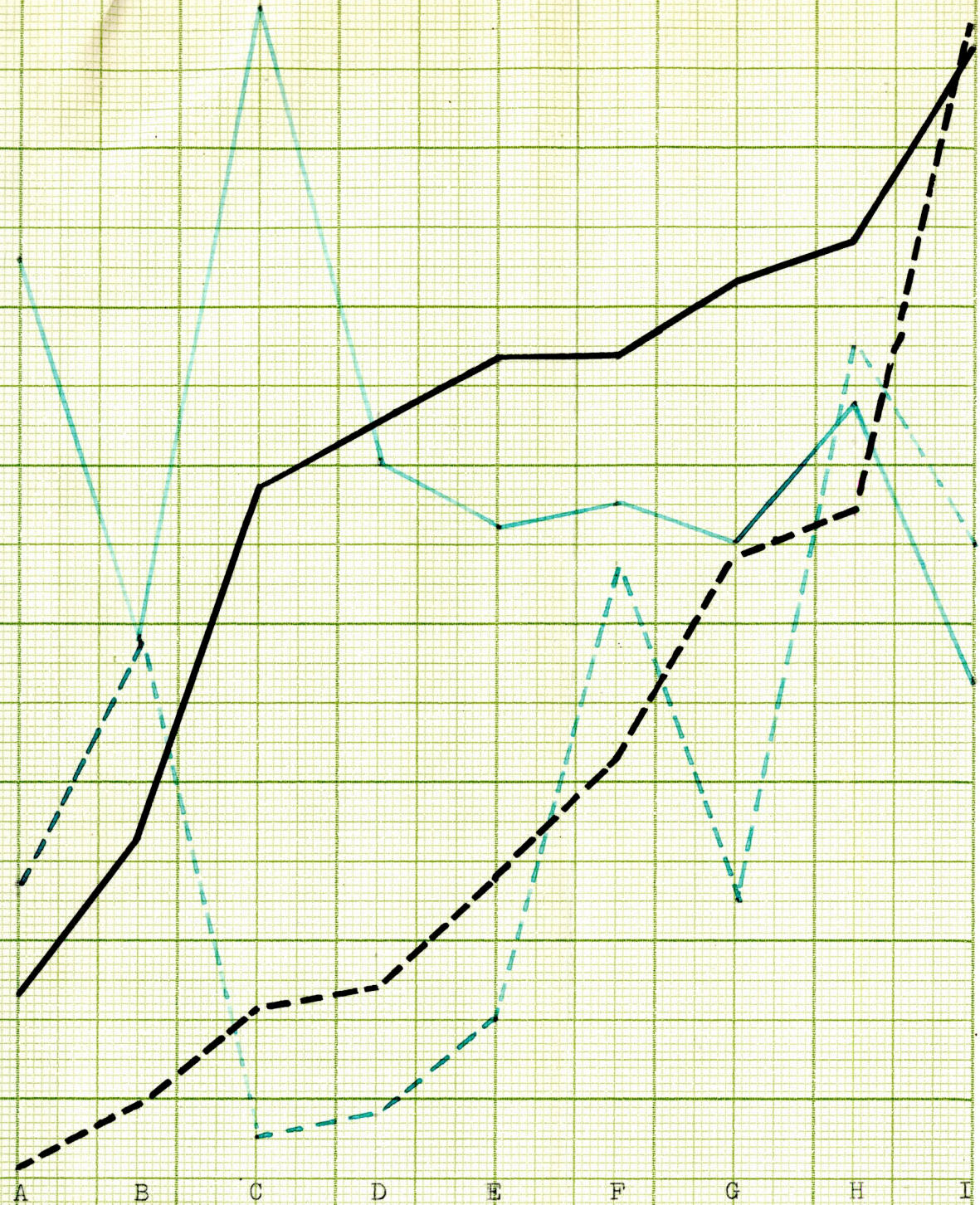
Activity in avge. number of yds. per min.

Figure 3

- - - Activity in avge. number of yds. per min., Group I
——— Activity in avge. number of yds. per min., Group II

- - - Sleep in avge. number of mins. during school nap, Group I
——— Sleep in avge. number of mins. during school nap, Group II

Leg length in percent of total recumbent length	Activity in avge. number of yds. per min.
0.448	48.1
0.446	47.0
0.444	45.9
0.442	44.8
0.440	43.7
0.438	42.6
0.436	41.5
0.434	40.4
0.432	39.3
0.430	38.2
0.428	37.1
0.426	36.0
0.424	34.9
0.422	33.8
0.420	32.7
0.418	31.6
0.416	30.5
0.414	29.4
0.412	28.3
0.410	27.2
0.408	26.1
0.406	25.0
0.404	23.9
0.402	22.8
0.400	21.7
0.398	20.6
0.396	19.5
0.394	18.4
0.392	17.3
0.390	16.2

Subjects: A B C D E F G H I

Figure 4

Activity in avge. number of yds. per min., Group I
Activity in avge. number of yds. per min., Group II

Leg length in percent of total recumbent length, Group I
Leg length in percent of total recumbent length, Group II

gravity, and thus better able to manage themselves than are
children whose leg length is, say, 39% or 45% of their total
length. That the optimum leg length ratio is reached during
the age period between the groups (thirty-seven to fifty-one
months) with corresponding heightened activity is suggested
in the analysis of Figure 1.

Analysis of Figure 5

The relationship between general nutritional condition
according to the rank given each subject and amount of ac-
tivity is not clearly defined but in general in both groups
the moderately active children tend to rank highest in gen-
eral nutritional condition while the most active rank higher
than the least active. With our present limited knowledge
it would be difficult to say whether the amount of exercise
affects the nutritional state or the reverse. It may be
that moderately active children get optimum exercise to in-
duce good circulation, elimination, and muscle tone (three
of the criteria of nutritional condition), very active chil-
dren wear themselves out and so suffer the deleterious ef-
fects of fatigue and nervous exhaustion, and inactive chil-
dren lack the exercise necessary to good bodily tone. On
the other hand the general nutritional condition may deter-
mine to a large extent the usual activity level of the indi-

Figure 5

General nutritional con-
dition

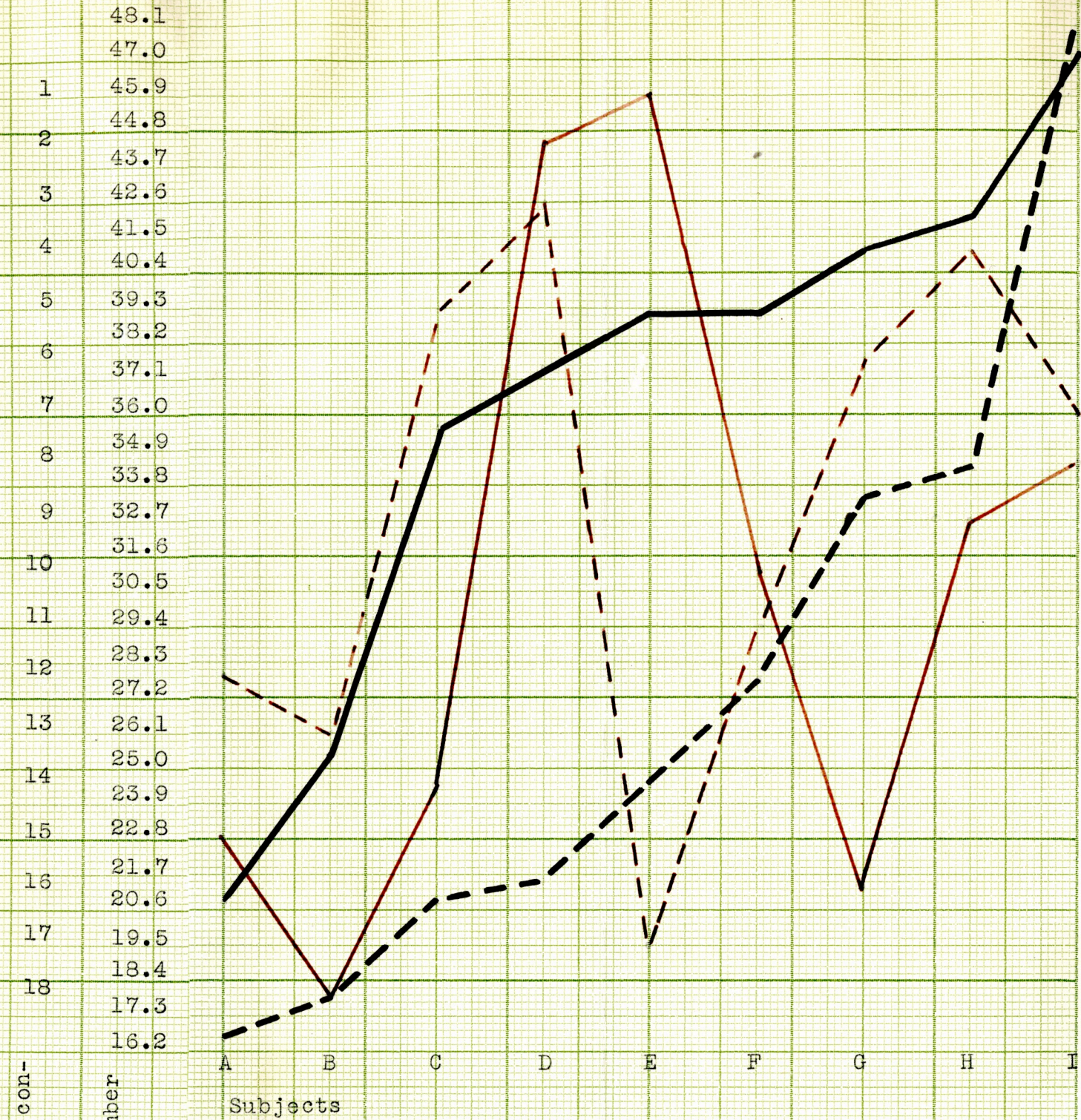Activity in avge. number
of yds. per min.

Subjects

- - - Activity in avge. number of yds. per min., Group I
——— Activity in avge. number of yds. per min., Group II
- - - General nutritional condition, Group I
——— General nutritional condition, Group II

vidual. The indication remains however that good nutritional condition accompanies moderate activity level and a high activity level is to be preferred to a low as far as nutritional status is concerned.

Analysis of Figure 6

There is no evident relationship in this study between carpal age and general nutritional condition. In Group I physical age is not related to general nutritional condition but in Group II the curves are somewhat similar. As has been pointed out in the analysis of Figure 1 the explanation probably lies in the fact that the two factors have been interactive over a longer period of time in the Group II children.

There is some evidence in Figure 6 of a positive relationship between mental age and general nutritional condition. It is barely possible that the nutritional state may directly affect mental growth, or that the brighter children have more intelligent parents, who are more careful and better able to maintain a high nutritional level.

Analysis of Figure 7

The curve representing extroversion scores according to
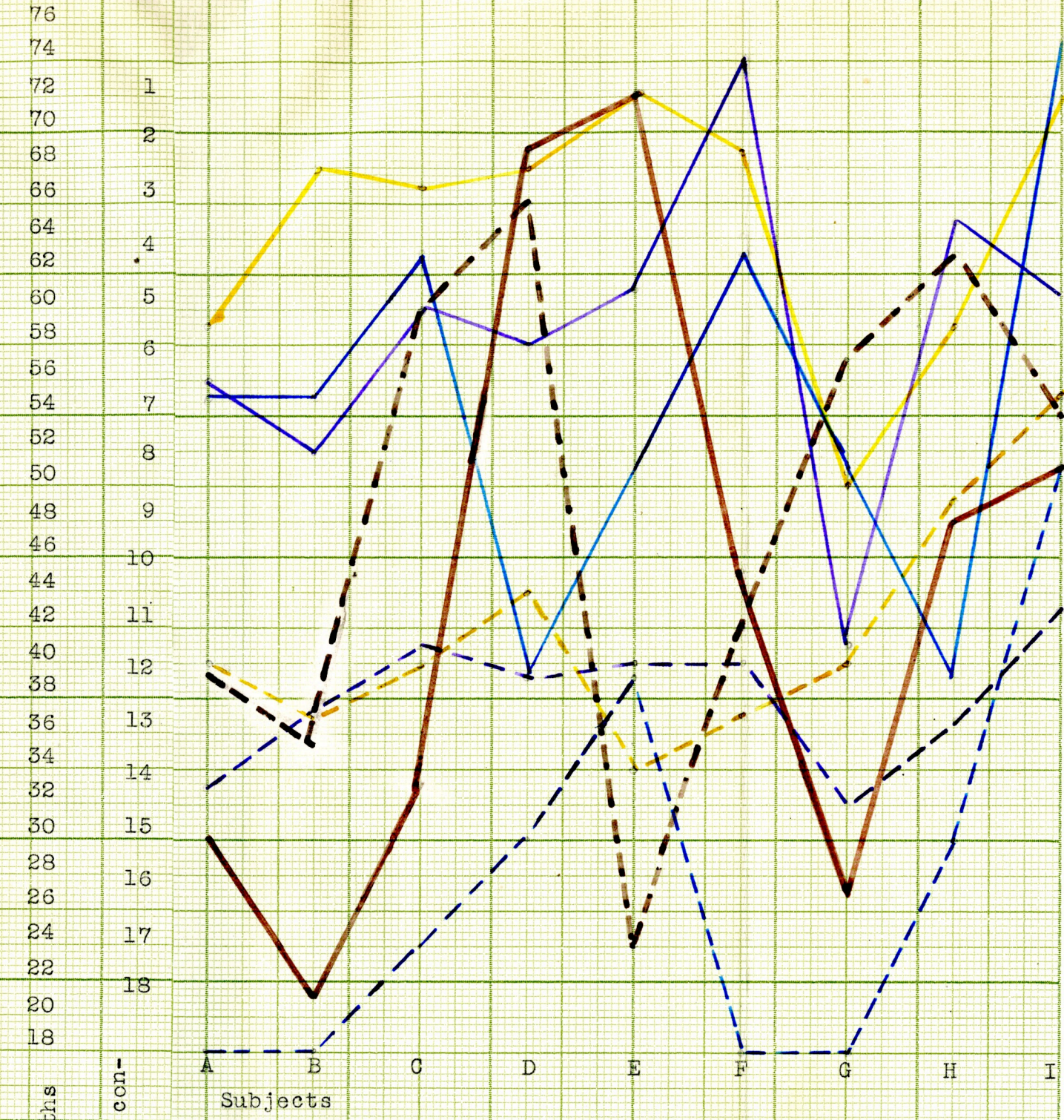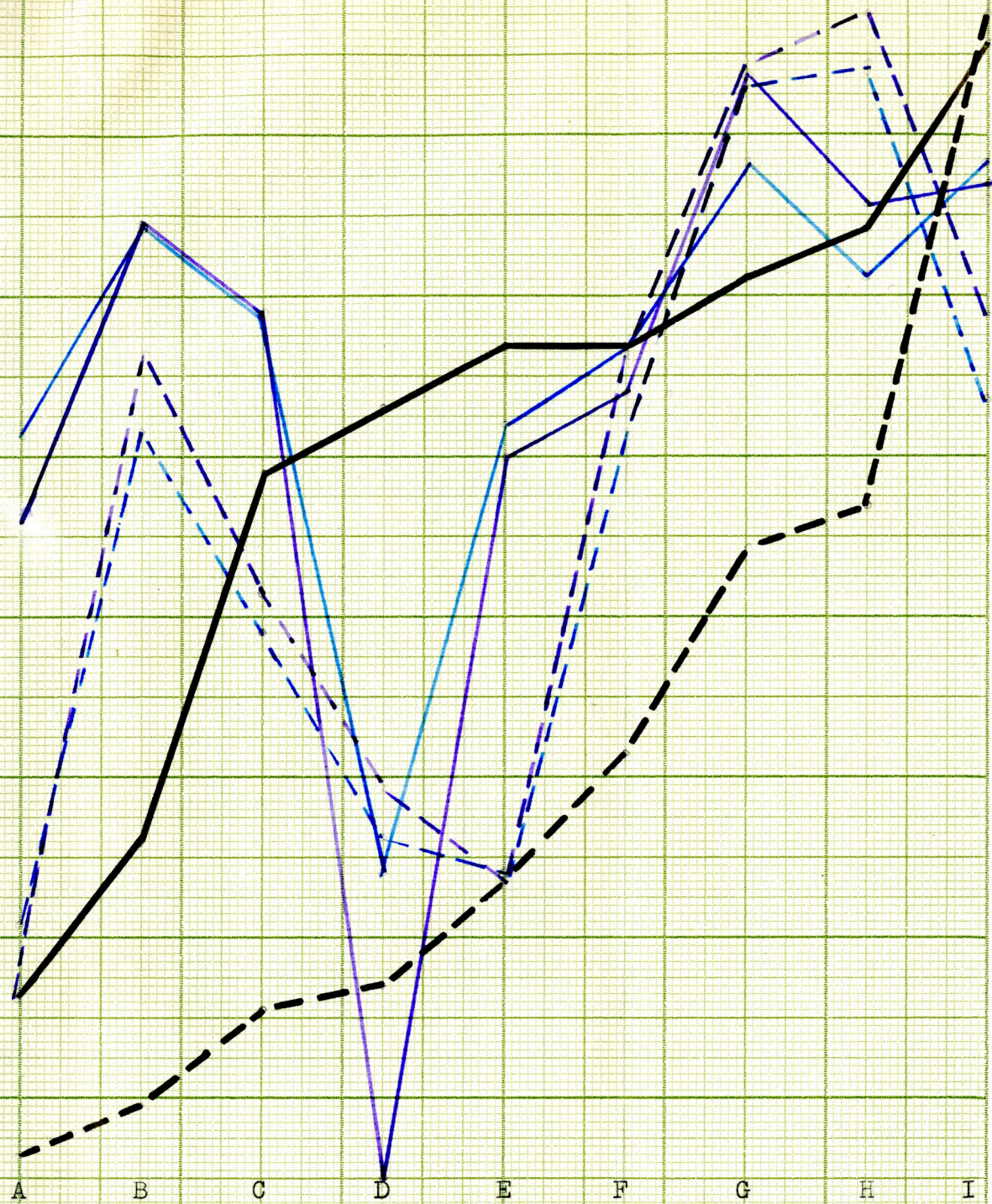
Figure 6

General nutritional condition, Group I
General nutritional condition, Group II
Mental age in months, Group I
Mental age in months, Group II
Carpal age in months, Group I
Carpal age in months, Group II
Physical age in months, Group I
Physical age in months, Group II

Mental, carpal, and physical age in months

General nutritional condition

Subjects

A B C D E F G H I

Extroversion score according to complete scale and to energy traits	Activity in avge. number of yds. per min.								
4.58	48.1								
4.46	47.0								
4.34	45.9								
4.22	44.8								
4.10	43.7								
3.98	42.6								
3.86	41.5								
3.74	40.4								
3.62	39.3								
3.50	38.2								
3.38	37.1								
3.26	36.0								
3.14	34.9								
3.02	33.8								
2.90	32.7								
2.78	31.6								
2.66	30.5								
2.54	29.4								
2.42	28.3								
2.30	27.2								
2.18	26.1								
2.06	25.0								
1.94	23.9								
1.82	22.8								
1.70	21.7								
1.58	20.6								
1.46	19.5								
1.34	18.4								
1.22	17.3								
1.10	16.2								

Subjects: A B C D E F G H I

Figure 7

Activity in avge. number of yds. per min., Group I
Activity in avge. number of yds. per min., Group II
Extroversion score according to entire scale, Group I
Extroversion score according to entire scale, Group II
Extroversion score according to energy traits, Group I
Extroversion score according to energy traits, Group II

energy traits (5, 6, 7, 14, 15, 16, and 17) was used as well as that representing extroversion scores according to the entire scale in order to secure a picture of the activity factors of extroversion unmodified by the social and emotional traits included in the latter. The general trend of the two extroversion curves as thus presented is the same although that based on the energy traits gives a cleaner cut profile of the activity factors of extroversion, individual differences being more sharply defined and the extremes more divergent.

In both groups the moderately active children are the least extroverted and the most active children more extroverted than the least active. Since extroversion is by definition the skeletal expression of emotion one would expect the least extroverted children to be the least active, a combination found in only one case, A-I as compared with three, D-I, E-I, and D-II who although introverted are moderately active.

It is interesting to note that in spite of the inherent bimodity of the Scale no child attained the perfect introversion score of 1 or the perfect extroversion score of 5.

Analysis of Figure 8

In both groups there is a marked positive relationship between general nutritional condition and quantity of diurnal sleep. Which is the causative factor it would be difficult to say.

In Group I there is a fairly marked positive relationship between general nutritional condition, quantity of diurnal sleep, and extroversion score. In Group II the general nutritional condition and quantity of sleep tend to a negative relationship with the extroversion score.

Analysis of Figure 9

The marked positive relationship in both groups between speech quantity and degree of extroversion may confirm Marston's conclusion that his rating scale is diagnostic of introversion and extroversion or, since eight of his twenty traits (1, 2, 4, 8, 9, 17, 18, and 19) involve speech quantity, it may mean that his scale is "padded" on the speech side. If Marston has not attached undue importance to speech quantity as an evidence of degree of extroversion then we may in the future find speech quantity studies valuable in diagnosing introversion and extroversion.
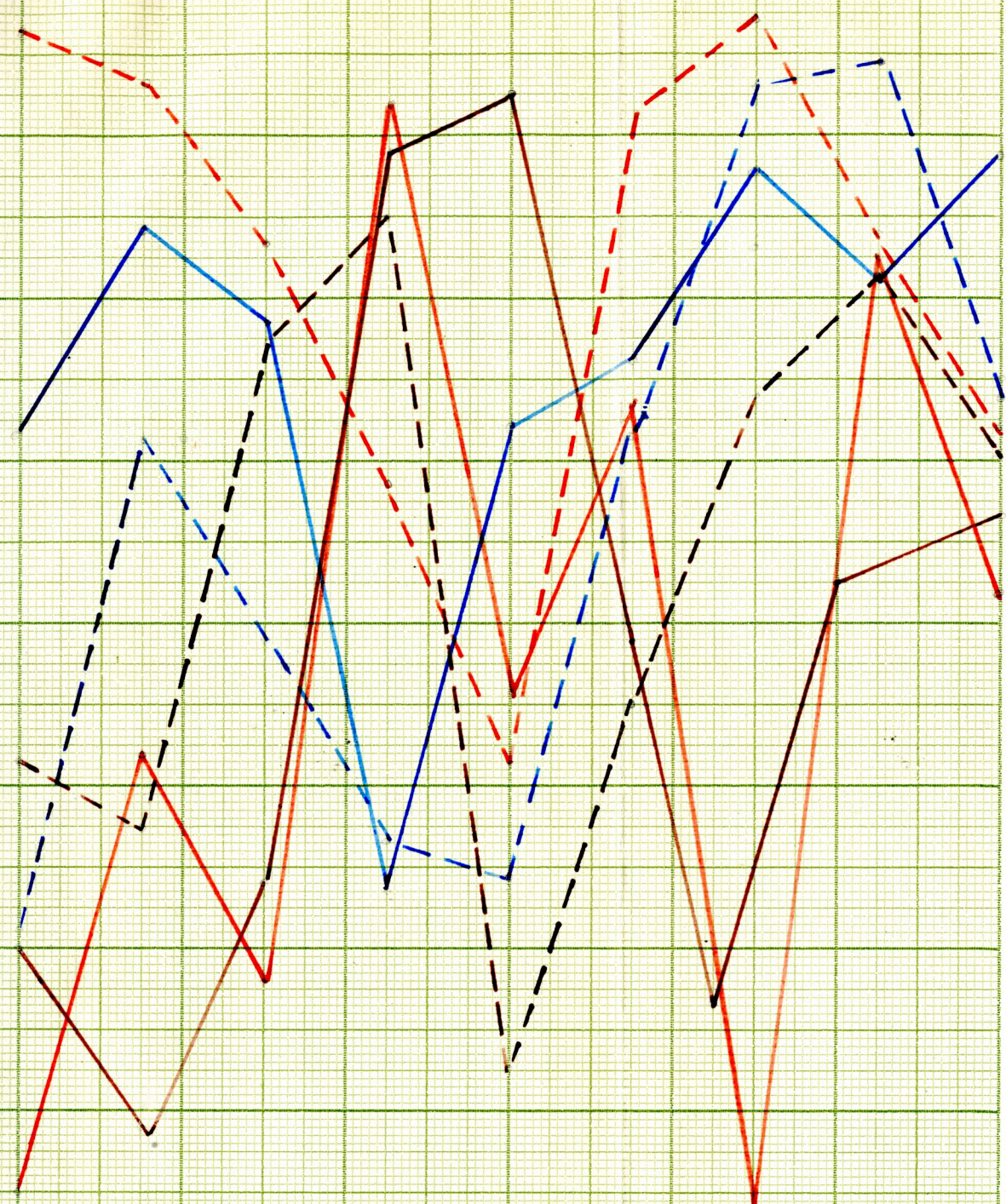
Figure 8

Extroversion score according to entire scale

Sleep in avge. number of mins. during school nap

General nutritional condition

Subjects: A B C D E F G H I

Extroversion score according to entire scale	Sleep in avge. number of mins. during school nap	General nutritional condition
4.58	85.5	
4.46	83.0	
4.34	80.5	1
4.22	78.0	2
4.10	75.5	
3.98	73.0	3
3.86	70.5	4
3.74	68.0	
3.62	65.5	5
3.50	63.0	6
3.38	60.5	
3.26	58.0	7
3.14	55.5	8
3.02	53.0	
2.90	50.5	9
2.78	48.0	10
2.66	45.5	
2.54	43.0	11
2.42	40.5	12
2.30	38.0	
2.18	35.5	13
2.06	33.0	14
1.94	30.5	15
1.82	28.0	
1.70	25.5	16
1.58	23.0	17
1.46	20.5	
1.34	18.0	18
1.22	15.5	
1.10	13.0	

Legend:
- - - General nutritional condition, Group I
——— General nutritional condition, Group II
- - - Sleep in avge. number of mins. during school nap, Group I
——— Sleep in avge. number of mins. during school nap, Group II
- - - Extroversion score according to entire scale, Group I
——— Extroversion score according to entire scale, Group II

Speech in avge. number of words per min.	Extroversion score according to entire scale	Mental age in months
14.5	4.58	76
14.0	4.46	74
13.5	4.34	72
13.0	4.22	70
12.5	4.10	68
12.0	3.98	66
11.5	3.86	64
11.0	3.74	62
10.5	3.62	60
10.0	3.50	58
9.5	3.38	56
9.0	3.26	54
8.5	3.14	52
8.0	3.02	50
7.5	2.90	48
7.0	2.78	46
6.5	2.66	44
6.0	2.54	42
5.5	2.42	40
5.0	2.30	38
4.5	2.18	36
4.0	2.06	34
3.5	1.94	32
3.0	1.82	30
2.5	1.70	28
2.0	1.58	26
1.5	1.46	24
1.0	1.34	22
0.5	1.22	20
0.0	1.10	18

Subjects: A B C D E F G H I

Figure 9

- Mental age in months, Group I
- Mental age in months, Group II
- Extroversion score according to entire scale, Group I
- Extroversion score according to entire scale, Group II
- Speech in avge. number of words per min., Group I
- Speech in avge. number of words per min., Group II

There is little evidence of relationship between mental age and either extroversion or speech quantity. However it must be borne in mind that since mental tests for young children are as yet inaccurate, the mental ages calculated from them are at best only an approximation.

Analysis of Table II

In Group I the boys are on the average more active than the girls by 5.8 yards per minute, two months older chronologically, two months older mentally, five months older physically, and fourteen months older carpally. The girls are more talkative by an average of 0.3 of a word per minute, sleep 19.3 minutes longer in the daily school nap, have longer legs in proportion to their total length, are more extroverted, and are better nourished.

In Group II the boys sleep on the average 12.2 minutes longer in the daily nap. The girls are more active by 8.9 yards per minute, two months older mentally, one month older physically, fourteen months older carpally, more talkative by 0.9 of a word per minute, more extroverted and better nourished. There is no difference in chronological age or in leg length in percentage of total length.

In Group I the girls are less active and sleep longer than the boys while in Group II they are more active and

TABLE II.

Sex Differences

Subject	Activity in avge. yds. per minute	Chronological age in months	Mental age in months	Physical age in months	Carpal age in months	Speech in avge. words per minute	Sleep in avge. mins. during school nap	Leg length in percent of recumbent length	Rank according to general nutritional condition	Extroversion score according to entire scale	Extroversion score according to energy traits
Girls – Group I											
A – I	16.4	36	40	33	18	0.1	84.0	0.405	12	1.84	1.75
B – I	18.2	36	37	37	18	3.4	81.2	0.417	13	3.31	3.53
D – I	21.6	35	44	39	30	2.0	56.7	0.393	3	2.16	2.23
F – I	27.8	36	37	40	18	4.4	78.6	0.421	11	3.35	3.56
G – I	33.5	35	40	32	18	5.2	85.4	0.404	6	4.35	4.44
H – I	34.4	36	49	37	30	4.8	72.8	0.432	4	4.39	4.58
Average	25.3	36	41	36	22	3.3	76.5	0.412	8.2	3.23	3.35
Boys – Group I											
C – I	20.7	38	40	41	24	2.1	72.2	0.392	5	2.72	2.82
E – I	24.6	36	34	40	39	0.6	39.2	0.398	17	2.03	1.99
I – I	48.1	39	55	43	51	6.3	60.3	0.422	7	3.42	3.68
Average	31.1	38	43	41	38	3.0	57.2	0.404	9.7	2.72	2.83
Difference between averages of boys and girls Group I											
	5.8	2	2	5	16	0.3	19.3	0.008	1.5	0.51	0.52
Total average of Group I											
	27.3	36	42	38	27	3.2	70.4	0.409	8.7	3.06	3.18

TABLE II. — Continued

Girls – Group II

C - II	35.1	55	67	60	63	13.3	25.7	0.449	14	3.66	3.69
E - II	39.0	56	72	61	81	5.9	43.1	0.423	1	3.37	3.26
F - II	39.0	53	69	74	63	7.8	62.7	0.424	10	3.58	3.47
G - II	41.0	53	50	41	51	10.2	11.7	0.422	16	4.11	4.43
I - II	47.6	54	72	61	75	12.0	50.4	0.415	8	4.18	4.09
Average	40.3	54	66	59	61	9.8	38.7	0.427	9.8	3.78	3.79

Boys – Group II

A - II	20.9	55	59	56	55	9.1	13.0	0.437	15	3.31	3.05
B - II	25.4	55	68	52	55	11.9	40.2	0.417	18	3.97	3.97
D - II	37.2	53	68	58	39	4.5	79.7	0.426	2	1.99	1.10
H - II	42.0	53	59	65	39	10.2	70.5	0.429	9	3.82	3.99
Average	31.4	54	64	58	47	8.9	50.9	0.427	11.0	3.27	3.03

Difference between averages of boys and girls
Group II

	8.9	0	2	1	14	0.9	12.2	0.000	1.2	0.51	0.76

Total average of Group II

	36.4	54	65	59	55	9.4	44.1	0.427	10.3	3.55	3.45

Difference between total averages of Group I and Group II

	9.1	18	23	21	28	6.2	26.3	0.018	1.6	0.49	0.27

sleep less. The boys of Group II have practically the same average activity as the boys of Group II while the girls of Group II exceed the girls of Group I in approximately the ratio 8:5. The boys of Group II sleep less than the boys of Group I in approximately the ratio 5:6 while the girls of Group II sleep less than those of Group I in approximately the ratio 1:2. These ratios suggest that in a nursery school environment girls between the ages of approximately thirty-six and fifty-four months experience a great acceleration of amount of physical activity and a parallel decrease in quantity of diurnal sleep, while boys remain nearly stationary at a mid-point. The implication seems to be that the rate of increase in amount of physical activity does not progress uniformly but in waves, a period of increase, a period of rest, and a period of increase, and that the waves do not coincide for the sexes but are alternate. If, on the other hand, the degree of physical activity depends upon external stimuli it may be that the nursery school is offering greater stimulation to the girls of this age than to the boys.

The girls in both groups are better nourished than the boys according to the judgments of raters familiar with their condition.

The girls of both groups are more extroverted than the boys. Moreover Group II is more extroverted than Group I,

the increase in extroversion being the same for the boys as
for the girls. These results do not coincide with those of
Marston who found the boys of his study "significantly more
extroverted than the girls", and a decrease in extroversion
with increase in chronological age, "a change more apparent
in the case of the girls".

The girls of both groups are more talkative and also
more extroverted than the boys, another indication of close
relationship between amount of talkativeness and tendency to
introversion or extroversion. The girls of Group II are
more talkative than the girls of Group I and the boys of
Group II exceed the boys of Group I, the ratio in both cases
being approximately 3:1, suggesting that there are no sex
differences in the rate of increase of speech quantity in
young children.

SUMMARY OF RESULTS

1. There is evidence of a period of heightened physical
   activity (gross bodily movement) during the age period
   between thirty-eight and fifty-three months. If the
   data are representative of all children at the ages
   studied the heightened activity may be due to the at-
   tainment of a leg length ratio (probably about 42% of
   the total recumbent length) optimum for gross bodily

movement perhaps because of better balance which makes
for ease in managing the body.

2. In general the most active children in this study are
   also the most talkative.

3. The amount of diurnal sleep taken by the children of
   this study decreases with increase in chronological age.
   The older children display greater individual variation
   in the length of nap than do the younger.

4. According to the data of this study a moderate activity
   level goes with a good nutritional condition and a high
   activity level is preferable to a low as far as nutri-
   tional statue is concerned.

5. The brighter children studied here are better nourished
   and older carpally and physically. It is barely possi-
   ble that they have more intelligent parents who maintain
   a good nutritional level. That these tendencies are
   more apparent among the older children may be due to the
   longer period of time they have been subjected to fac-
   tors favorable or unfavorable to growth and development.

6. The moderately active children of this study are the
   least extroverted and the most active more extroverted
   than the least active. Extroversion scores based on
   energy traits (5, 6, 7, 14, 15, 16, and 17) of the Mar-
   ston Scale give a cleaner cut profile of activity than

those based on the entire scale.

7. The better nourished children in both groups here studied sleep longer.

8. The close positive relationship here shown between degree of extroversion and talkativeness suggests the possible value of speech quantity records as an index to prevailing tendency to introversion or extroversion.

9. There seems in this study to be no clearly defined direct relationship between amount of activity and mental age, physical age, and carpal age, or between mental age and degree of extroversion, or between mental age and speech quantity.

10. These data offer evidence that in a nursery school environment the rate of increase in amount of physical activity with increasing chronological age progresses in waves and that the waves are alternate for the sexes. If the amount of physical activity depends upon external stimulation the nursery school may be offering greater stimulation to girls between the ages of thirty-six and fifty-four months than it does to the boys of like ages.

11. There are no apparent sex differences among these children in the rate of increase of speech quantity with increasing chronological age.

SUGGESTIONS FOR FURTHER STUDY

It has been pointed out that this study was made with the hope of opening new lines of inquiry concerning the attributes of physical activity as such. The following suggestions for amplification of ensuing studies of gross bodily movement are the result of observation and reading.

1. Relation of amount of gross bodily movement to concentration as evidenced by the length of time spent by the subject on consecutive plays, games, and apparatus during the normal day's program.

2. Relation of mental speed to physical speed.

3. Relation of calcium matabolism to nerve irritability.

4. Relation of mental to physical fatigue.

5. Effect of activity on the acidity of the urine.

6. Relation of vital capacity, circumference of the chest, and circumference of the thigh to activity.

7. Test of muscular strength, perhaps as evidenced by the gripping strength.

8. Length of the labor and nursing periods.

9. Health history, particularly with references to the number and virulence of the diseases suffered.

10. Vision and hearing.

11. Posture, especially the condition of the feet and ankles.

12. Area of bodily surface.

13. Basal metabolism.

14. Nutritional history.

15. Daily habits of elimination, including consideration of enuresis.

16. Appetite, including analysis of the daily food intake.

17. Weight and character of the clothing.

18. Stimuli which call forth physical activity. A suggested classification is other children, adults, constructive toys, outdoor play apparatus.

19. Chronological age, by studying groups of children at each age level.

20. Effect of weather on amount of gross bodily movement.

21. Order of the subject in the family.

22. Relation of behavior problems to the usual activity level.

LITERATURE CITED

Average Heights and Weights of Children Under Six Years of Age. Childrens Bureau Pub. No. 84, 1921.

Chassell, C. F.
1924.   The Army Rating Scale Method in the Kinder-
garten. Jour. of Educ. Psych., 15:43-52.

Flemming, B. M.
1926.   Study of the Quantity of Sleep and Behavior
of Nursery School Children During School
Nap. Merrill-Palmer School Files, Detroit.

Freyd, M.
1924.   Introverts and Extroverts. Psych. Rev.,
31:74-87.

Gates, G. S.
1923.   An Experimental Study of the Growth of So-
cial Perception. Jour. of Educ. Psych.,
14:449-461.

Hinkle, B. M.
1922.   A Study of Psychological Types. Psychoen.
Rev., 9:107-197.

Jung, C. G.
1919.   Psychological Types. Harcourt,Brace, & Co.
N. Y.

Kempf, E. J.
1921.   The Autonomic Functions and the Personality.
Nervous & Mental Diseases Pub.Co.,Washington

Marston, L. R.
1925.   Emotions of Young Children. University of
Iowa, Iowa City.

Mattson, M. L.
1926.   Study of Factors Affecting Speech Activity
in a Group of Nursery School Children.
Merrill-Palmer School Files, Detroit.

McDougall, W.
1921.   Is America Safe for Democracy? Scribner,
N. Y.

Nicoll, M.
1917.   Dream Psychology. Hodder & Stoughton,
London.

Pryor, T. W.
1915.   Some Observations on Ossification of the
Bones of the Hand. Ky.Medical Jour.,
13:481-485.

Rotch, T. M.
1910.   Safeguarding Early Life. N. Y. Medical
Jour., June 8.

Tansley, A. G.
1921.   The New Psychology and its Relation to Life.
Dodd, Mead, N. Y.

Terman, L.
1925.   Genetic Studies of Genius. Stanford U.
Press, Vol. 1.