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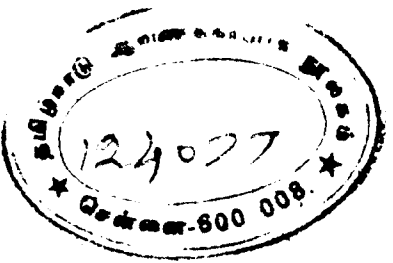
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The Psychologists' Concept of Mind

EDWIN G. BORING
Harward University

Certainly the Cartesian dichotomy between mind and matter has been, at least during the last three centuries, the basic distinction in the taxonomy of existence. Matter is believed to be palpable extended substance, whereas mind, while it may be localised in the living organism, is nevertheless impalpable and unextended, a reality that occupies no more space than does a soul. Indeed Descartes' division between the spiritual and the material, between *l'ame* and *la matiere*, was peculiarly natural in the seventeenth century when scientists were not yet divorced from religion, and when the existence of a soul, at least in man, seemed indisputable. This mind-matter dualism has now been basic to philosophical thought for a very long time and has permeated common sense, where it still persists. Whether or not he believes in a soul, the ordinary man is sure that, besides tangible space—occupying objects, there somehow exists mind, which is intangible, is in man's head but occupies no space there, yet is observable and knowable at any moment of its existence, as is the thought that this sentence is now evoking or as is the present memory of yesterday's visitor.

The Establishment of Dualism

The formal history of how Cartesian dualism established itself as fundamental in the new experimental psychology of the late nineteenth century is easily reviewed.¹ John Locke, in inaugurating British empiricism in 1690, was opposed to Descartes in his belief that all of mind is generated in experience as sensation and reflection form it, writing upon it as if it were a piece of white paper. Descartes, on the other hand, believed that some ideas are innate. In modern terminology we might call Descartes an hereditarian, and Locke an environmentalist. The two philosophers were, however alike in that both were dualists. Descartes thought of the mind as performed and separate from the body which interacts with it. The brains, determines events in the mind which in turn cause actions in the nerves and muscles. Descartes has been called for this reason an interactionist, whereas Locke was but half an interactionist, for his empiricism consists only in the external world of material bodies acting through sensation to form the mind. The important point is that both schools reinforced dualism, the conception that mind and matter are different kinds of realities.

¹ The author's own *A History of Experimental Psychology*, 2 ed. Appleton-Century-Crofts, 1950, gives in fuller detail most of the historical facts cited in this paper, although that volume does not discuss the present topic nor bring the facts into their present relationship. All the references to original sources are given there, and it seems unnecessary either to repeat them here or to refer constantly to the various relevant pages in this other volume.

Both dualism and empiricism were kept alive in the eighteenth century by British empiricism—notably by Bishop Berkeley (1710) and David Hume (1740). Thomas Reid (1764) of the Scottish School also supported the dualistic tradition. In the nineteenth century empiricism came to embrace associationism, which was considered to be the principal empirical principle by which the mind is organised through experience. The paradigm for associationism is to be found in James Mill's *Analysis of the Human Mind* (1929), although it was his son, John Stuart Mill, who did most to prepare the way for the new experimental psychology, which presently came to be called *physiological psychology* and established itself in Germany in the latter half of the nineteenth century.

In the 1850s two important books were published that were greatly to influence the new scientific psychology. The earlier was R. H. Lotze's *Medizinische Psychologie* (1852), a philosopher's physiological psychology, which was both dualistic and empiricistic in its fundamental premises. It was known in later years especially for its empirical theory of the way in which the conception of space is generated in experience, a view which formed the background for Hermann von Helmholtz's empiricism and also the opposition for Ewald Hering's nativism. Lotze's psychology also was dualistic. Philosophers of all kinds tended to maintain this fundamental dichotomy of reality.

The other book was Alexander Bain's *The Senses and the Intellect* (1855), another physiological psychology written by a philosopher. Bain too was a dualist and empiricist. Later he wrote *Mind and Body* (1872), in which he argued against Cartesian interactionism and in favour of what others came presently to call *psychophysical parallelism*. In those days the doctrine of the conservation of energy was new and Bain considered that the brain could not act upon mind without some transfer of energy from brain to mind, nor mind upon brain without a contrary transfer. He was wrong. A cause and its effect do not have to be quantitatively equivalent in energy. The energy of the cause may create the effect by the release of other energy.

Nevertheless the great importance of this new physical law did, indeed, serve to enhance the respect of psychologists for the fundamental qualitative disparity between mind and body. Nearly all the new experimental psychologists of the period 1860–1900 were psychophysical parallelists. They believed that mind and brain, and therefore mind and matter, are two distinct kinds of being that cannot interact. The mental events are attached to certain physical events in the brain in such a manner that they parallel these particular actions. "No psychosis without neurosis," said T. H. Huxley in 1874; but, of course, no one thinks that the reverse is true. It is only particular events in nerve tissue, perhaps only in certain kinds of brain tissue, that are always paralleled by conscious events. No other physical occurrences are supposed always to have mental concomitants.

Fechner's great *Elemente der Psychophysik* of 1860, the book that is sometimes thought to have been the beginning, at least as far as books are concerned, of the new experimental psychology, was basically dualistic in its major assumption. It

is true that Fechner's intention was to establish the functional relation between sensation and stimulus, and thus between mind and matter, so that he could claim that the spiritual and material worlds form together a single unity; nevertheless, his whole procedure presupposed the initial separation between sensation and stimulus, between mind and matter, and actually between mind and brain. So it came about that Fechner's effort to demonstrate an ultimate monism had the effect of emphasizing the initial dualism with which he began.

The establishment of the new experimental psychology in the late nineteenth century, with its laboratories and brass instruments, under the leadership, as it is customary to say, of Wilhelm Wundt at Leipzig, tended further to fix dualism upon the psychology. For one thing the new psychology was a direct descendant of British empiricism and associationism. Empiricism asks how external bodies generate mind and thus how stimulus generates sensation—Locke's question, as it were—whereas the intent of Fechner and psychophysics was to answer just that question. For this reason it was quite natural that the new experimental psychology should begin with research on psychophysics and sensation. It was a long time before memory and learning were brought under experimental control (H. Ebbinghaus, 1885) and a still longer time before thought and motivation felt the scientific yoke (N. Ach, 1905). The experimental method itself is, however, dualistic, for an experiment is an observed correlation between a dependent variable and an independent variable. In psychophysics the dependent variable is the sensation (mind) and the independent variable the stimulus (matter).

The end of the nineteenth century saw dualism and psychophysical parallelism pretty well established in German psychology. Psychology is the study of mind or consciousness, said the psychologists, and introspection is its method. Wundt and Oswald Kulpe were representative of the German view, and E. B. Titchener at Cornell University in the United States stood with them, though the main trend of American psychology was in another direction. These three men certainly would have liked to see it possible to create a scientific descriptive psychology of the mind with no reference whatsoever to stimulus or to nervous system. None of them could, however, come near success. The law of association was the only law expressed wholly in terms of consciousness to be found in Titchener's system: when two ideas occur together, the recurrence of one tends to reinstate the other. Everything else had to do with stimulus or other external objects, or else with the brain, nerves, or the sense-organs.

When this phase of psychology passed after World War I, Germany was left with Gestalt psychology as its chief experimental movement, but Gestalt psychology tended also to be dualistic, as is indicated by its important theorem of psychophysiological isomorphism (Max Wertheimer, 1912), the topological correspondence between the perceptual pattern (mind) and the corresponding excitatory pattern in the brain. The less experimental psychologies in Germany—*Verstehenspsychologie*, phenomenology, existentialism—all tended to remain subjective, to consider mind as a different kind of being from matter, whereas the Americans, as we shall see in moment, went the other way toward an objective monism. There

may be a national psychological difference here. The German psychologists are more philosophical than the American; they accept the importance of taxonomy more readily; their demand for functional significance is less strong. All this will become clearer when we turn to the Americans.

The British have lagged behind Germany and the United States in experimental psychology. They were never strong introspectionists, but they seem nowadays to accept subjectivism from the European Continent more readily than do the Americans. They are also somewhat less ardently set than the Americans toward functionalism, in spite of the fact that it was their Darwinian tradition that the Americans took to support their functional interpretation.

The American Revolution

In the United States in the 1880s and 1890s the efforts of the psychologists to find out what was going on in the new psychology in Germany and to import it to America must have looked very different to them than as they participated in the new movement than it does to us now with a perspective of seventy years upon the events. The *Ortgeist* of America was functional. It was practical and set for achievement, a society moved by success as a goal. It has been said (F. J. Turner, 1893) that America has a pioneer culture, the success-culture of the frontiersman who for more than two centuries lived in a country where there was always free unoccupied land to the west where man might go, were he but strong enough to wrest a living from nature. America lacked, moreover, the stabilizing effect of having a history, for it had no long past except what it could claim in Europe from which it fought to free itself. It was a brash, hard-driving, impetuous country, and toward its ancestral culture in Europe it was ambivalent, like an adolescent youth's relation to his parents. Americans looked abroad with respect and then boasted of their own superiority. When they heard about Darwin's theory of evolution in the 1870s, they accepted it—nearly all of the scholars competent to judge it did—with alacrity. America believed that the survival of the fittest is a proper law of nature.

The first American of great intellectual caliber to get wind of the new German activity in experimental psychology was William James of Harvard. He went abroad to find out more about the new movement and he read what the German researchers were doing. He even set up a little informal laboratory at Harvard in 1875, the same year that Wundt established a similar one at Leipzig. (The important "first" laboratories came later: Wundt's at Leipzig in 1879, Stanley Hall's at Johns Hopkins in the United States in 1883.) In 1878 James started to write his great *Principles of Psychology* which finally was published in 1890. In it he was undertaking to provide significance for the German movement, but actually he was less impressed by the German experiments than he had expected to be. His book was the first in the new American tradition; it was a functional psychology. It was, moreover, dualistic. James had not abandoned the concept of mind as distinct from brain and matter, but neither was he content with a taxonomy of consciousness as Wundt might have been. Something about the spirit of America controlled him, that and the spirit of Darwin. He wrote in his book of the significance and use

of mind, and he put the German experiments down into fine print. The *Ortgeist* controlled him.

The pioneers of American psychology, if we mention only those who had great and long-lasting influence, were James, Stanley Hall, and James McK. Cattell. Hall was a wide-ranging, practical psychologist, an erudite man who cared little for the fine distinctions of the Germans, an entrepreneur, who introduced experimental psychology to America by founding its first formal laboratory, who initiated the study of child psychology, and was the first American psychologist to take psychoanalysis seriously as he invited Freud and the other analysts to the celebration at Clark University in 1909. He illustrates better than James the functional bias in America.

Perhaps Cattell illustrated it still better. Cattell was Wundt's first American student at Leipzig, and, arriving there in 1883, he informed Wundt that he needed an assistant and that he, Cattell, would be it. No respectful German would have dared to be so brash. Cattell, moreover, influenced by Darwinian theory, was impressed with the importance of studying individual differences in abilities. Wundt would have none of that, so Cattell conducted and completed these researches outside the Leipzig Institute in his own rooms. He returned to America in 1886 and four years later published the paper which was first to use the term *mental test*, a paper in which he listed most of the measuring devices of Wundt's laboratory as potential instruments for testing and to which Sir Francis Galton, the British entrepreneur for the testing of human abilities, appended an approving appendix. Cattell's ambivalence is clear but it is doubtful that he recognized it in himself. Like James he thought he was introducing the new German psychology to America, without realizing how much he was changing it as he adapted it to fit the American scheme of values.

At the University of Chicago from 1894 to about 1912 there flourished, at first under the influence of John Dewey and then with James R. Angell, a specific school of functional psychology. These men, like Hall and Cattell, believed that psychologists should interest themselves in any kind of human behaviour or ability, but the school was nevertheless dualistic. Consciousness was held to exist because of its use to the organism.

It was John B. Watson, one of Angell's students at Chicago, who founded behaviourism at Johns Hopkins University about 1913. Watson was working with the sensory discrimination and the learning of animals, and he had no interest at all in the taxonomy of their consciousnesses, if, indeed, the animals could be proved to be conscious. He proposed, therefore, that psychologists give up the concept of consciousness, ignore the fact and deal only with behaviour. Since it is only by behaviour that other organisms, animal or human, ever communicate the facts of their consciousnesses to science, it was plain that any organism thought to be conscious must be exhibiting describable behaviour. It was not so hard to make this change, and by and large America turned behaviouristic. Titchener still stood out for introspectionism until his death in 1927 and he had adherents, but in the 1920s American psychology was predominantly behaviouristic.

Watson's radical behaviourism, as it was called, was philosophically naive, but in the 1930s it was replaced by operationism. That shift was initiated by the psychologists' discovery of P. W. Bridgman's *The Logic of Modern Physics* (1927), which proposed the reductionist principle that, since no object or event can be known to have more attributes than observation can show to be inherent in it, the properties of objects and events can best be understood by reducing them to the operations by which they are observed. This view of science outlaws dualism at once, for consciousness can be known only by the behaviour—the verbal report or other actions—that indicates its presence and character. If an unknowable consciousness, one that does not reveal itself through behaviour, exists, it has no place in science (though it might in metaphysics). Watson had already equated introspection to observable verbal report, but Bridgman made the rules more certain and precise, and presently the American psychologists found a still more sophisticated, physicalistic, monistic philosophy in the logical positivism of the Vienna Circle. Herbert Feigl was their first emissary to America, but later Rudolph Carnap and others came from Europe.

By 1940 American psychology had pretty well gone behaviouristic, or physicalistic or operationistic—the particular terms do not matter. Titchener's introspectionism had vanished. The Gestalt psychologists still remained supporting a dualism of phenomena or, as Wolfgang Kohler called it, direct experience—to be correlated with brain process; but these men were few.

After World War II the term *behavioral science* came into vogue, a practical device for bringing American psychology closer to social science without taking it away from its relation to biological science. Theoretical psychology was now cast in terms of behaviour. The theories of E. C. Tolman and Clark Hull were essentially behavioural. B. F. Skinner was the most insistent supporter of a physicalistic operationism from 1931 on to the present. It seems correct to say that, in America in 1959, mind is no longer consciousness; it has turned into behaviour.

The Concept of Mind

Mind is discriminative behaviour. That seems to me to be the consequence of this long development from Descartes to the modern American positivists. Whenever an organism chooses, that is to say, whenever it acts differentially in respect of something else, there is a sense in which it may be said to be aware of that something else. Where awareness is, there is mind.

I stop at the fork in the road, then go to the right, because I have read the sign. I remember reading the sign. That is mind in operation. I avoid this woman at the reception and engage in conversation with a man, because the woman looked like an aunt I disliked as a child; but I do not remember the aunt. My unconscious is at work. That too is mind. The rat turns to the right in the maze without knowing why. The real reason is that he learned so to turn yesterday. That is mind working. The spider builds the special web of his species and does not know why. The real reason is that his ancestors learned this kind of web-architecture. That is mind. If you wish to push logic to its limit, then the vine that twines itself about the pole is aware of the pole, though it has no comment to make to itself

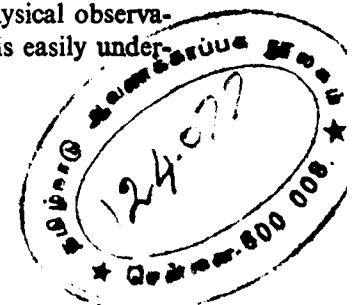
about its awareness, and the ocean, responding by its tidal behaviour to the location of the moon, is similarly aware of the moon. These are the kinds of relationships that are specifically discriminatory and they are the class of relationships with which psychology is, for the most part, concerned.

That view is, it seems to me, rigorous and inescapable. It is the modern positivistic, ~~physicalistic~~ behavioristic view of mind, a definition of the subject matter of psychology. It is, however, reductionism carried to an extreme. The data of science must be generally observable, and what is publicly observable is physical and is never a Cartesian unextended mysterious non-matter.

On the other hand, there are canons of good sense and convenience to be kept in mind. You can believe in the reducibility of mind to discriminative behaviour without taking time off to perform the reduction. Reduction is useful when disagreement is rife, for it narrows the area of possible dissent. Otherwise it may be convenient to forget about it. I hold firmly to the belief that this table is made of molecules, but in dealing with the table ordinarily I forget about this reduction. The problem at hand does not call for that analysis and, though a reduction remains possible, it need not be made.

Even in America, with its current positivistic revolution, a ⁴⁰⁰ great deal of what used to be called the content of introspection remains in scientific use. It is all reducible to behaviour, but no one bothers. Reduction is not called for. We still use the phenomenological protocols of the Gestalt psychologists. How else describe a perception to see if it is isomorphic with the field excitation in the brain? We still judge and scale sensations and their attributes in psychophysical research. The problems of sensory scales are in the forefront of research today. The psychotherapists still listen to patients' protocols, to their reports of dreams and anxieties and fears. The comparative psychologist would do well to follow the therapists' example and admit awareness and perception and choices to his animal subjects. He thinks of them in these anthropomorphic terms, and it is a pedantic discipline that makes him reduce the normal psychological terminology to its positivistic and artificial ultimates. It is true that some of the old subjective concepts are gone. Straight dualism is pretty much gone, at least among American psychologists. Classical introspective analysis in terms of sensations and images and their attributes is gone. No more does the introspective account include reports of Franz Brentano's acts or of Kulpe's impalpable awarenesses and imageless thoughts. Yet a great deal is left, the items that work, the ones that get knowledge forward through research.

My final word is this. Use those concepts of mind that promote science with the least awkwardness, the least circumlocution, but, when confusion or disagreement arises, try reducing the concepts to their operational equivalents. So often reduction shows you what to trust and where to become suspicious. The sensible thing is to work with a practical pluralism and to get your research done. If you get into trouble, then you can always retreat by reduction to the physical observational ultimates, for this transformation process is now known and is easily understood.



The Stability of Raven's Coloured Progressive Matrices Scores for Selected Children

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A. Introduction

The coloured Progressive Matrices, sets A, Ab and B were constructed as a suitable test for use with children who are for any reason mentally subnormal or impaired. Like the scores made on a number of verbal or concrete intelligence tests, the results obtained from this test are used in making decisions which often have far reaching effect upon the lives of these children. Since this test is used to differentiate the mentally retarded children from those of average or of superior intelligence, it is imperative that there be in the literature an evidence on the stability of the scores derived from this test, so that whenever this test is used to diagnose intellectual deficiency in children and to separate the intellectually retarded from the normal child, the correct decision can be made with confidence and in the light of considerable experience and empirical study.

Stability studies of the coloured Progressive Matrices test have been made in some cases, with groups of intellectually superior children, but to date there is hardly any published study of the stability of the scores on this test for a sample of Indian Children suspected of being or who are mentally handicapped.

B. Purpose

The purpose of this study was to determine the relative stability of the scores derived from the coloured progressive matrices test for a sample of children who had very poor school records and who were reported by their teachers to be intellectually retarded.

C. Procedure

80 school children whose school records were very poor and who had secured the last five places at their annual examinations in their respective classes were selected from four upper primary and middle schools as subjects. These children were reading in classes IV, V, VI and VII. Their ages ranged from 9 years to 12 years approximately, with a mean age of 10.2 years.

Coloured Progressive Matrices Test was applied to these children in January and February 1959 and their scores were obtained. These children were retested with the same test in December 1959. No child was retested in less than 10 months after the initial test and the mean number of months intervening between the initial test and the retest was 10.8 months. The group consisted of 62 boys and 18 girls.

D. Results

Mean and median scores for the initial test and the retest are given in Table 1. The difference between the two means is only 0.2. Accidentally the difference between the two medians also happens to be 0.1. These differences are apparently not significant at all. Student's 't' for the difference between the two means is only 0.5 which is not significant at all.

An analysis of the differences between the scores, without reference to the direction of the difference, was made for each paired set of scores in the sample. Table 2 contains the summary data for this analysis. These data indicate that for 13.75% of the cases there was no difference at all between the scores of the initial test and the retest; that for 50% of the cases the difference between the scores of the initial test and the retest was only two or less than two and that for 75% of the cases this difference was 3 or less than 3. The highest difference obtained was 6, but this difference was found only in 2 cases.

TABLE 1

Mean Scores, Median Scores and Differences (N = 80)

	Initial Test Mean Score	Retest Mean Score	Diffe- rence	Initial Test Median Score	Retest Median Score	Diffe- rence
Full scale sets A, Ab and B ...	21.3	21.5	0.2	21.3	21.4	0.1

TABLE 2

Differences in the Scores for the Initial Test and the Retest without regard to the Direction of the Differences (N = 80)

Differences between the scores of the initial test and the retest	N	Per cent of Sample
6 or fewer scores ...	80	100.00
3 or fewer scores ...	78	97.5
4 or fewer scores ...	75	93.75
3 or fewer scores ...	60	75.00
2 or fewer scores ...	40	50.00
1 or fewer scores ...	29	36.25
No difference at all ...	11	13.75

E. Summary and Conclusions

Eighty Primary-school and Middle-school children whose school records were very poor and who had secured the last five places at the annual examination in their respective classes were tested and retested with Raven's Coloured Progressive Matrices Test. No child was retested within fewer than 10 months after the initial test and the mean number of months intervening between the two tests was 10.8.

Results of the initial test indicated that as a group these children were definitely below average in intellectual capacity. Since their mean score of 21.3 lay below the 25th percentile as compared with the norms prepared by Raven's (1956) for children between the ages $9\frac{1}{2}$ and $1\frac{1}{2}$ years

Two different analyses have been presented which demonstrate that scores on the coloured progressive matrices are as relatively stable for children with very poor scholastic achievements as are the scores on this test for normal and intellectually superior children, and as also are the scores on the W.I.S.C. (1949) when that is used with intellectually backward children.

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Cognitive Controls and Primary Processes¹

ROBERT R. HOLT

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During this anniversary year, I have had the great pleasure of realising a dream that had been with me throughout the 13 years since I left Harvard. At the Research Center for Mental Health in New York University, we have finally gotten under way a programme of inter-related researches cast in a familiar mold: a sizable group of experimenters, some of them graduate students, some more elderly types like George Klein and myself, who are directing the work, all carrying out our personological researches on the same small group of subjects, who are intensively studied and assessed (cf. Murray et al., 1938). When someone invents a better general model for research in this area, I hope I shall not be so much blinded by sentiment and nostalgia as to be unable to adopt it; meanwhile, the old model seems to have plenty of power and mileage left in it.

Our researches cluster around three major themes, all of which are related by the kind of psychoanalytic ego psychology that we profess: the problem of perception and cognition outside of awareness (cf. Klein, Spence, Holt and Gourevitch, 1958), the problem of the structural organization of cognitive processes (cf. Gardner, Holzman, Klein, Linton and Spence, 1959), and the problem of their relationship to drives and to primitive, archaic modes of thinking (cf. Pine and Holt, in press). In a more telegraphic style, we speak of these as the problems of preconscious cognition, cognitive controls, and primary process.

The work I want to describe briefly includes both of the latter two themes. It began with the decision to try to make Freud's concepts of primary and secondary processes concrete and operational enough to work with them experimentally. The familiar defense mechanisms and a few other concepts had been explored and exploited frequently in the laboratory, but none of these was as central to psychoanalytic theory as this neglected pair of basic concepts.

Let me remind you briefly of some definitions: the primary process is thinking that is dominated by drives, rather than by fidelity to reality and logic; and it is characterized by certain formal properties, chiefly the dream-work mechanisms of condensation, displacement and symbolization, and autistic rather than rational logic. The secondary process corresponds more closely to the official version of human thought promulgated by logicians and philosophers, as the realistic exercise of reason. It is purposive, organized for effective goal-striving instead of being dominated by drive. This contrasting pair of definitions is intended to bring to mind an image of a continuum defined by its idealized poles, not a simple dichotomy.

¹ Paper presented at the Twenty-fifth Anniversary Celebration of the Harvard Psychological Clinic, Cambridge, June, 1957. It is published here as read, with only the addition of footnotes.

Freud never offered a concise, pointed definition of the primary process: rather he provided us with a number of somewhat heterogeneous descriptive characterizations (cf. Freud, 1900). And, in fact, others after him have found it difficult to state any single, simple defining principle that would include everything recognized by analysts to be part of this ancient common heritage of mankind, shared by sage and savage, child and madman alike.

Nevertheless, if we want to take a more or less standard sample of cognitive behaviour, such as the Rorschach performance, and make a microscopic scrutiny of the protocol for evidences of the primary process, Freud's writings and those of other analysts offer many concrete and helpful guidelines. This is just what I did in setting up a primary process scoring system. I took quite literally what I found in the psychoanalytic literature, translated it into the terms of Rorschach percepts and verbalizations, and came up with a set of scoring categories. This method is embodied in a four-part manual which describes 25 content categories, 28 formal aspects, 46 types of control and defense associated with primary process manifestations, and an over-all rating of the S's emotional reaction to taking the test.¹ To use this method, you read each response of the Rorschach record, keeping in mind all these possibilities, and whenever you recognize any of the manifestations of primary process specified under the content or formal categories, you record the corresponding score on special scoring sheets.

You will recall that in defining the primary process I distinguished between its drive-directedness and such formal properties as the dream-work mechanisms. The scoring system contains corresponding divisions into content and formal categories. Reasoning that a person who is taking the Rorschach test is not pursuing any obviously sexual or aggressive goal, I have assumed that if imagery relating to these drives appears, it reflects not purposive goal striving, but drive-dominated cognition and, as such, is primary in nature. The manual lists the usual libidinal partial drives—oral, anal, exhibitionistic-voyeuristic, etc., and also subdivides aggressive contents into images conveying potential aggression (such as "a tiger crouched to spring"), active aggression ("people fighting"), and the results of destructive action (e.g., dead or injured persons or animals).

In addition, all of these content categories are divided into the more blatant, directly drive-related expressions, called Level 1, and more socially acceptable, toned down, and derivative expressions, called Level 2. For example, a Level 1 oral response would be "a huge gaping mouth"; a Level 2 oral response would be "a dish of ice cream."

¹ This statement was written at a time when an earlier version of the manual was being used. In the current revision (Holt, 1959), there are 26 content categories, 36 formal scores and 47 controls and defenses. In addition, there are now four ratings to be made for each response in lieu of the overall rating: form level, creativity, defense-demand (i.e., the degree to which the response would be unacceptable as a communication in polite society, without some kind of cushioning or modification), and defense-effectiveness (how well the defenses used to satisfy the response's defense-demand). The last takes into account the Control and Defense categories scored, the form level, and the S's effective reaction to his response, which we are currently eliciting by a special "affect inquiry" along with the usual inquiry on determinants, etc. The defensive contribution of these aspects of the response is also being scaled quantitatively.

The formal aspects of primary process thinking are more heterogeneous and harder to summarize. They include signs of condensation, symbolization, fragmentation, loose and fluid associations, autistic logic, contradiction, and a few miscellaneous features of primary process thinking. The formal variables are divided into two levels also, Level 1 being those that are closer to the primary process pole, Level 2 those that are further up towards the secondary end of the continuum.

Every response that is given a formal or a content score must also be considered for the degree of control that is built into the percept or its communication. We score 7 major types of controlling and defensive devices, in addition to form level or accuracy; the context of responses (intellectual, artistic etc.), reflections about them (criticism of the response or introspection about it), the perceptual organization of responses, their sequence, the degree of remoteness or distance built into the response, delay of response (for example, bringing out the idea that two people are fighting only during the inquiry), associated affective reactions, and a few miscellaneous (mostly pathological) defenses.

At this point, I imagine that you may feel slightly bewildered by this brief description of a complicated scoring system, which requires a 40-page manual to be made reasonably clear.¹ If you do, your reaction speaks for the complexity of the phenomena that we denote by the deceptively simple term, primary process. It refers to a *class* of related types of cognition. There is every reason, therefore, to expect to find individual differences in primary process functioning. And I'm not just referring to variations in the content of individual experience—the fact that, for example, various symbols for any one theme may exist; I want to suggest rather than perhaps some people's primitive thinking relies heavily on symbolism, while others may be pervaded by condensations, still others are characterized by wishful drive-laden imagery, and so forth.

As soon as I start to speak about characteristic individual modes of thinking, I recognize that my ideas owe a great deal to my friend and co-worker, George S. Klein. He has developed the concept of cognitive controls and styles to conceptualize the types of consistency found in perceptual and other cognitive behaviour, and has experimentally isolated a number of specific principles of control. A cognitive control is a structure, in the sense that it refers to a relatively stable and enduring aspect of the psychic apparatus that guides response and may incidentally give it an individual flavour and contribute to its efficiency or inefficiency (cf. Klein, 1958). It is therefore a part of the ego; but the primary process is usually referred to the id, when it is spoken of in terms of the tripartite model. It might seem, therefore, that the two would be quite separate, and that individual penchants in conscious and in unconscious cognition might be unrelated.

We know, however, that the id and whatever is unconscious are known to us only *via* the (conscious) ego, and certainly in the Rorschach we are limited to communicated conscious cognition, no matter how much primary process we may see in it. It seemed to me, therefore, that people with contrasting cognitive controlling

¹ The manual is now half again longer.

principles might be expected to differ in their primary process manifestations, particularly if these cognitive controls had been shown to be relevant to modes of dealing with drives.

Operationally, a cognitive control-principle is defined by a specific task, usually one that does not involve any obviously conflictful or emotionally relevant content. But what is an analogy of drive-organized thinking that is relevant to drive-control and yet relatively conflict-free? Experience with the Rorschach test (among other considerations) suggested that the presence of colour poses such a problem to perceptual-cognitive behaviour. Colours act as if they were the perceptual equivalents of affective drive-derivatives, even when they are presented relatively abstractly, and people differ remarkably in their ability to handle colours smoothly in interpreting the Rorschach blots.

A separate and independent task was required, however, and the Stroop Colour-Word Interference test seemed admirably suited to the purpose. It consists of, first, a list of colour-words (e.g., red, blue, green, yellow), typed in regular black ink and repeated in random arrangement enough times to make up a double-spaced typed page (Stroop, 1935; Klein, 1954). At a signal, the subject reads these off aloud as quickly as he can. Next he is given a sheet on which are typed clusters of asterisks printed in different colours of ink, the same number of clusters as words on the previous page, and similarly arranged. The subject now reads off the colours of the inks as rapidly as he can. Finally, he must read as rapidly as possible the colours of the inks from a third sheet with the same number of typed words, like the first except that the colour words are typed in non-matching inks—for example, B-l-u-e in green ink, to be read as "green." Everyone finds it more difficult to read the third series than the second, but there is a wide range, on both the second and third series.

At first glance, there may seem to be a considerable difference between the nature of this task and the dependent variables from the Rorschach. Note, however, that in most general terms, the primary process is to ordinary waking communicated thought what noise is to an informational channel. The Colour-Word Interference test puts in another kind of noise and requires the subject to perform as efficiently as he can in spite of it. Partly the interference comes from the colours themselves, and the necessity to perform the unaccustomed act of naming them as quickly as possible. For most persons, however, the main noise in the system is the overlearned habit of responding to a word in terms of the meaning denoted by its pattern, which must be disregarded in the final, critical series of the Stroop test. Naming the colours of the ink in which the words are typed, when the words are shouting at you to say the wrong colour name, requires a constant inhibition—or a capacity to achieve an odd kind of dissociation.

At any rate, it seemed to me quite possible that performance on this task might predict the handling of primary process material in the Rorschach. In brief, it does. Comparing subjects (Ss) who do well with those who do poorly on the Colour-Word test, I found a heartening number of statistically reliable differences, using two

non-parametric tests (Fisher's Exact Test for 2×2 tables, and the Mann-Whitney U-Test).

Let me say next a few words about the samples from which I have chosen extreme Ss. I began with a small handful, 13 in all, who had been Ss. for George Klein in his Harvard thirst experiment (Klein, 1954). He was good enough to let me use their Rorschachs, and I got my first hunches from an intensive study of these few cases. Since then, both the Colour-Word test and the Rorschach have been given to about two dozen freshmen in the New York University School of Education, and to 60 very assorted Ss. in Topeka, including some college students, nurses, aides and wives of staff members at the Menninger Foundation, plus a few patients. Pooling all of these 97 cases, and applying certain criteria¹ uniformly to all of them, I have selected 15 who performed with consistent ease on all parts of the test, and 20 who did badly on both naming colours alone and the critical third series—the interference task. These results derive from three quite different samples; therefore, they are a certain kind of cream skimmed from a large pool. I think that it is fair to say that if relationships emerge through the heterogeneity of these assorted groups, they may be assumed to be relatively free of sample bias.

We find, first of all, that subjects who do poorly on the Colour-Word test—let's call them 'Distractables'²—find the Rorschach something of an ordeal, typically. They tend to give fewer responses ($p = .05$), with less colour ($p = .02$) and less movement ($p < .05$), than their opposite numbers, but with more sighing, squirming, nervous laughter and other signs of tension. Yet they are not markedly

¹ The criteria actually used were multiple, considering simultaneously scores on Part II (colours alone), Part III (the critical interference series), and the ratio $\frac{III-II}{II}$, the measure used by Klein (1954). I adopted the more complex criterion because I noticed that some Ss in the extreme groups on Klein's measure were interfering with the general trends. On closer scrutiny, some of these turned out to have very high ratios because they did unusually well on II and moderately poorly on III, while others had low ratios because they did poorly on II and not particularly badly on III. So for the undistracted group, one of the following conditions had to be met: the performance on II (colours alone) was under 61" and that on III (interference) under 90", while the ratio was less than .55; or the score on II could be up to 63" (III still being under 90") if the ratio was .30 or less.

For the Distractable Ss, one or the other of the following conditions had to be met: the reading time for II had to be over 61", that on III over 105", and the ratio $\left(\frac{III-II}{II}\right)$ greater than .70; or, II could be as low as 46", III 105" or more, if the ratio was 1.20 or higher.

There is therefore some overlap between the groups on part II, colours alone, though in general the groups are well separated. The means are:

	II	III	Ratio
Undistracted (N = 15)	56.5	80.6	43.1
Distractable (N = 20)	65.3	125.8	.94
Total group (N = 96)	59.46	99.17	.678
(ranges)	(41-82)	(61-153)	(.29-1.37)

The scores for the S who is discussed at the end of the paper were not included in the above means and ranges for the total group.

² I am not following the terminology I suggested to Klein (1954) for his extreme groups (flexible vs. constricted control) because somewhat different criteria are involved in his and my selection of extremes. See footnote 4.

constricted; the median R is 27.5, median ratio of movement to colour 3:3. The comparable figures for the Undistracted group are: R, 40; M, 4; sum colour, 5.

Keeping in mind these general trends, let us look at the evidences of the primary process in the Rorschachs. To hold the effect of differences in R roughly constant, the total number of responses containing clear references to drives (primary process content) and evidences of unrealistic modes of thought (formal signs of primary process) are expressed as per cent of R. When we do this, we find that the Undistracted group has a somewhat larger total proportion of primary process ($p < .10$). Their Rorschachs are especially distinguished from those of Distractible Ss. by having what I call Level 1 (more extreme) *formal* signs of the primary process ($p = .05$). For example, Undistracted Ss. significantly ($p < .05$) more often gave responses in which the image is a composite that does not occur in nature: people with wings, a bear with two heads; often they made these more socially acceptable, so to speak, by taking advantage of culturally given composite images, such as centaurs, or many-limbed Hindu gods. Surprisingly, the only other single formal category to differentiate the groups significantly ($p < .05$) is Fragmentation—the *Do* response, which was found only in the Undistracted group, the ones who did well on the Colour-Word test.

In terms of Content, the groups did not differ significantly in the proportion of responses that express the *n* Aggression in its various forms, but the Undistracted Ss. gave more responses with libidinal content ($p < .005$). In particular, they were more likely to allow themselves obvious and blatant expression of oral needs ($p < .05$). In one content category, however, the *Distractibles* gave a higher frequency of response than did the Undistracted Ss.: those representing anxiety without any specific drive reference—mostly percepts of things falling or tumbling down ($p < .02$).

Turning now to the realm of Control and Defense, we find only one category that was used frequently enough to differentiate the groups significantly. When an Undistracted S gave a response with Level 2 primary process material (either formal or content), he was more likely than a Distractible S to follow it by a neutral response to the same blot—that is, to shift back to the secondary process level of functioning ($< .05$). It is as if the more Distractible Ss were the captives of their primary processes: they were less likely to allow such material into awareness but once it had begun to emerge, they were relatively unable to stop, except by ceasing to respond to the card entirely.

In summary, Ss who performed smoothly and relatively undistracted by the perceptual “noise” of the Colour-Word Interference test also met the situation of taking the Rorschach easily and showed less signs of being afraid to let primary process show itself in their responses. Comparatively speaking, they were more responsive to the test in general, took it more calmly, with fewer indications of anxiety and disturbance or occasionally with positive enjoyment, and were able to give more responses with drive content or unrealistic formal elements, while having less difficulty in returning afterwards to a more secondary process level of responding. The fact that Fragmentation (*Do*) responses occurred only in this group suggests

that at least a few of them may have done well on the Colour-Word Interference test by a kind of dissociative breaking-up the perceptual experience. Performance scores on the Colour-Word test, then, are related to a person's capacity to use and feel comfortable with his primary process, and not to become so much threatened by it that he has to exclude it rigidly from conscious cognition, or to become disturbed if it emerges. More abstractly, it may be said that experimentally measured cognitive controls are related to the quantity and types of primary process manifestations, at least in the Rorschach test.

I want to conclude by telling you briefly about an extreme case, a 14½ year-old boy who on the whole was more disrupted by the Colour-Word Interference test than anyone I have seen. He took two minutes to read the second series, naming the colours of the asterisks, which is about twice the average speed of college students. On the third, critical series, he stumbled along, making many errors (which he mostly corrected) and finished in 3 minutes 40 seconds, a full 100 seconds longer than he had taken on colours alone. He took this test and the Rorschach in the same spirit of trying to be a good sport, but having obvious difficulty.

His first Rorschach response gives dramatic expression to some of his pressing conflicts: “This is a person in the middle, being pulled on by these two big people on the side, like they're trying to pull him apart. Looks like these people are pointing away at the same time, or may be they have wings.” There was no other response to the card. The response is scored for drive content—active aggression, Level 2 (it would have been Level 1 if the person in the centre were seen as being actually torn apart); it also gets the formal score Composition, Level 1, since it contains a fused image of man and bird, unbuffered by any mythological or other reference to a socially shared image, like that of an angel. On Card II, he saw a couple of rock and roll dancers, commenting that “the red spots in it don't mean anything.” On Card III he saw the usual human figures and again remarked on his inability to interpret the colour; he described the human figures as disturbing to him, because they seemed all mixed up, they didn't know who they were or what they were doing: “They want to do something they can't do, reaching for something they can't get at.” (This is an example of a response scored under the Anxiety category.) To quote only one more response, Card IX: turning it sideways, he saw the green area as “An Indian, riding a buffalo—looks like he's holding on, riding for life or death” (another response indicating instinctual anxiety). In the inquiry, when he again stressed that it was a buffalo, not a horse that the Indian was riding, I was vividly reminded of Freud's famous analogy of the id as headstrong horse and the ego as its uneasy rider.

This boy was indeed having trouble controlling his powerful impulses, which had almost literally run away with him. He was being tested because he had impulsively stolen a car and run away from school, trying to get to his parents, who lived across the country. He was an adopted child of a vain, beautiful and wealthy woman who had had several husbands during his brief lifetime, had adopted several other children and had seen very little of them herself, leaving them to the care of servants and hired parent-substitutes. The boy grew up confused about who

he was, where he came from, what he belonged to, rejecting his mother's "high society" values while longing for some human contact with her and never having a stable father figure with whom to identify and to help him build a sense of identity. With the onset of adolescence, he shot up to 6 ft. 2 in. and a muscular 180 lbs.—a man's body with a man's drives, and a stunted ego to manage them. He started acting out—fighting, running away, and finally the car theft. Yet in the hospital, where he was tested, he spent much of his time in fantasies of how to organize his days and control his life; he spoke wistfully of his desire that someone give him a set of definite rules and make him follow them. One could hardly ask for clearer clinical evidence that he was threatened by his drives, on poor terms with his impulses and his primary process, struggling to maintain control. And in this extreme subject, the same qualities were faithfully reflected in his performance on the Colour-Word test and the Rorschach. If all our cases worked out that neatly, we should be spared a great many of the headaches, but perhaps also a lot of the gratifications, of research in personality.

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Scientific Psychology in the Soviet Union

PROF. ALEXEI LEONTYEV

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The problem of sensory cognition of the surrounding world by man, that is, its reflection in the consciousness through sensations, perception and ideas, occupies a place of prime importance in scientific psychology. It is a question of the interconnection and interdependence of man's consciousness with and on the environment and the conditions of the material life of society.

Soviet psychology regards reflection itself not as a passive process, but as the active participation of man. It is this that determines the aims and tasks of Soviet scientific psychology.

It is a known fact that the consciousness of each individual person is the product of his development, that is, it depends on those concrete conditions under which this development takes place, on his upbringing and education.

It is, therefore, very important to know the general laws governing this development in order, on the basis of these laws, to influence actively the formation of that consciousness. In this field Soviet psychologists have a truly great opportunity, that of contributing to the all-round development of all the spiritual abilities of each person, of creating a new, a more highly developed person.

Laws Governing Development of Consciousness

What laws govern the development of the consciousness of each individual person and of society as a whole?

The consciousness of individuals is conditioned by society. Everything that man is conscious of, is perceived by him as a result of social practice, which is mastered by him from early childhood and leaves its impression on all aspects of his conscious activity. The formation of man's individual consciousness takes place in the process of his mastery of the *socially developed* ideas, conceptions, and views, which are the product of the generalization of social practice.

As a result of changes in the conditions of the material life of society, and the change in social-economic formations, the social consciousness also changes. This is necessarily reflected in the consciousness of each individual who lives in the given society, for the individual is subjected to the constant influence of that society, its ideology, the conditions of its life and those changes which take place in theme.

Soviet psychologists consider in their main task to understand the objective laws of the development and formation of the consciousness of man, the laws governing the formation of the mental qualities of the individual.

A knowledge of these laws is not merely of theoretical interest to the Soviet scientist; it is a necessary condition for the successful solution of the *practical task*, namely, that of knowing how to direct the mental development of the individual and to form the consciousness of man.

The unity of theory and practice is the guiding principle of Soviet scientific psychology.

Development of a New Man

The purposeful formation of the personality of each person, as is being effected by society in the direction of those goals which it has set itself, promises great possibilities for the development of a new man, a man with a new communist consciousness.

It may be asked: Is not this task a purely speculative, abstract ideal?

No, it is not. This task is successfully being fulfilled. In the Soviet Union profound changes are taking place in the consciousness and behaviour of people. New, valuable traits are being formed, and the survivals of the old society, all that was negative, that was handed down to us as the heritage of the past—are becoming things of the past. The spiritual and especially the moral outlook of Soviet people is changing ever more noticeably.

The rise in the cultural level of Soviet society is having a tremendous influence on the formation of the new personality, the new man. It has given rise to the mass flourishing of the talents and abilities of the people and has enriched them spiritually. The eradication of all discrimination and the wide practical opportunities given to man to study, to find himself, to advance in his development, have shown, in actual fact, how great are the spiritual potentialities latent even in those peoples who, in the recent past in Tsarist Russia, were considered to be the most backward.

Under these conditions Soviet psychologists considered it one of their most important tasks to investigate the process of the formation of the new qualities of the consciousness in Soviet people.

The aim which Soviet psychology serves is to achieve the all-round development of the personality.

Work of Soviet Psychologists

In order to solve this problem psychology in the U.S.S.R. has already accumulated a large number of experimental works and has prepared a substantial theoretical basis.

A wide study is being undertaken of the cognitive activities of man: his sensations and perceptions (the works of Ananyev and Sokolov), the processes of

memory (the studies of Zankov, Zinchenko and Smironov), the processes of thought and speech (the works of Rubinstein, Lurii, and Zhinkin). Considerable work is being done in studying the individual psychological differences in people, including questions of abilities (Teplov and Leontyev) and problems of character (Levito and Myasishchev). Much has already been done in connection with questions of developmental psychology, especially the psychology of younger children (Zaporozhets, Lyublinskaya) and a number of problems connected with educational psychology, the psychology of teaching and upbringing (Kostyuk, Menchinskaya, Bozhovich). The questions of occupational psychology and the psychology of art and sports, are also being studied.

This broad field of investigation by Soviet scientists has made it possible to establish many important laws governing the mental processes, intricate forms of mental activity and the development of the personality. Numerous opportunities for the purposeful development of individual mental traits of the individual have been discovered. The specific features of the age groups of mental development have been studied in detail, and their qualitative distinctive aspects, abnormalities in development and also the means of surmounting the latter have become known.

Unfortunately information about Soviet psychology as published by the foreign press are not always correct. Apparently, certain authors do not know or do not wish to understand what is actually taking place in Soviet psychology. Some of them, for instance, alleged that in the 1950's Soviet psychology apparently began to decline as a result of the "influence exerted on it by physiology", obviously having in mind I. P. Pavlov's teaching on higher nervous activity.

It needs to be mentioned with all emphasis that the profound penetration of the ideas of the great scientist, Ivan Pavlov in psychology has led, in reality, not to decline in psychology, not to its absorption into physiology, but, on the contrary, to the development of psychology and its strengthening as an independent science.

Reliability of a New Picture—Frustration Study

BY

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Rosenzweig's picture—Frustration study, adult as well as children's form, has been used by investigators for various purposes like study of cultural groups, prison inmates, neurotics and so on. Frustrations differ from culture to culture, and from time to time in the same culture. Situations which are considered to be frustrating in one culture may not have the same effect in another cultural set up. Identification with the frustrated person, which is assumed to be at the basis of the responses in tests of this type, is possible through role playing and role playing is facilitated by familiarity of the stimulus situations and hindered by unfamiliarity. Similarly the reactions to these frustrations are dependent upon the subject's ego-structure as moulded by the culture. Then, in order to study the true frustration reactions effectively, a picture-frustration test, uniquely suited to each cultural set up is called for.

A new picture-frustration test on the lines of Rosenzweig's P-F study (2, 4) was developed by the author for the age group 13-18 years. The test consists of 15 situations. Rosenzweig's scoring scheme (3) was followed with slight alterations to fit in the responses which are sometimes complex. The developmental procedure of the test, validity data and other results are yet unpublished. The reliability of the test has been found out and the results are reported here.

Reliability of the Rosenzweig's type of P-F study falls into two-classes—reliability of the scoring and the reliability of the test.

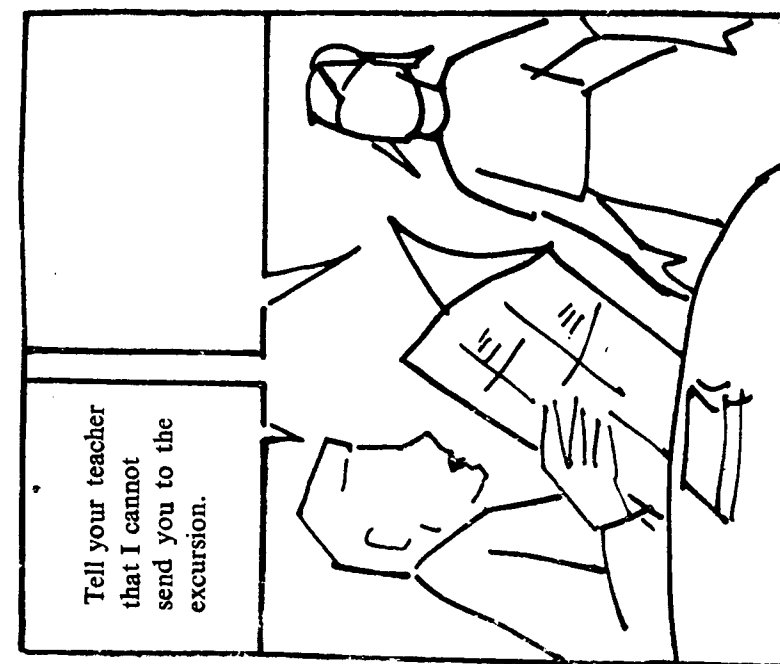
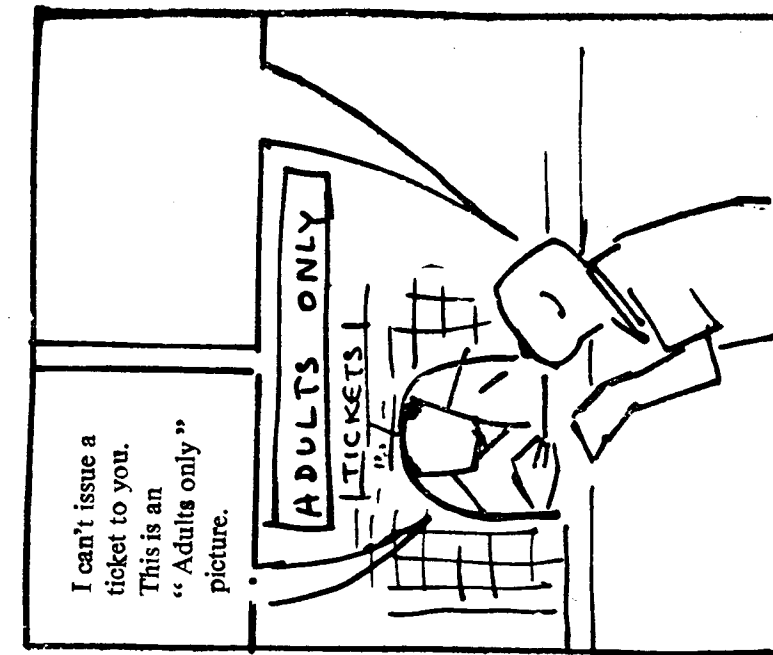
1. Reliability of the scoring

Reliability of the scoring has been found by comparing scorings of the same protocols by two independent persons. Udai Pareek (5) has quoted the results of scoring reliability obtained by other investigators. They all show that the agreement between two independent persons scoring the protocols is significantly high. Udai Pareek (5) in his study of the children's form (Indian adaptation) has reported reliability ranging from 70 to 96 per cent.

In the present study, the reliability of the scoring was studied by having two persons* score the same protocols independently. This was done in three stages.

In the *first stage*, 25 protocols were scored independently without any discussions regarding the scoring. Except for a typed copy of the scoring factors and their

*The author is indebted to Mr. M. A. Faruqi, Lecturer in Psychology, University of Madras who was the other rater along with the author.



Two Sample Situations

description, the other rater had no direct experience with the scoring categories of the P. F. study.

In the *second stage*, another 25 protocols were scored independently. Before doing the scoring, the various scoring categories and their usage were discussed in the light of some of the responses of the previous group.

In the *third stage*, another 30 protocols were scored by the two raters. The responses were read out and scored separately; the final scoring for each reaction was decided after discussions of the differences in scoring.

To determine the agreement between the raters, percentages were found out for the identical scorings. In cases where there was an agreement between the raters except for a double scoring by one of the raters, an agreement of 0.5 was recorded. For example, if the two scorings are E' ; M' and E' then the agreement is 0.5. This is the usual method followed in P-F study (1).

The following table gives the percentages of agreement between the raters on the 15 situations of the P-F study in three stages.

TABLE 1
Percentages of Agreement

Situations		I stage	II stage	III stage
1	...	32	52	95
2	...	32	64	100
3	...	62	74	87
4	...	50	69	89
5	...	42	74	84
6	...	42	72	93
7	...	64	33	80
8	...	48	52	90
9	...	32	46	87
10	...	34	42	89
11	...	42	35	87
12	...	40	42	100
13	...	40	62	96
14	...	48	64	84
15	...	38	46	96
Median	...	42	52	89

In the first stage, the scoring agreement ranges from 32 to 64 per cent. In the second stage, it ranges from 33 to 74 per cent. On the whole, there is an increase from the first stage to the second stage and in most of the situations there is a very good increase. In the final stage, the percentage of agreement ranges from 80 to 100. The medians for the three stages show that from the first to the third stage, there is a very good increase in agreement between the raters. This implies that better understanding of the scoring variables has led to a decrease in the disagreement between the raters. The reliability indicated by the above figures is quite high in view of the complexity of the responses. It is felt that the present scoring scheme is not wholly adequate; this will be examined in greater details in a later paper.

Reliability of the test

Reliability studies of the P-F tests have used two approaches. Some studies have found out the internal consistency of the scoring factors, others are concerned with the stability of these factors.

In a recent paper published by U. Pareek (5) a summary of the literature concerning the studies in this field is given. Generally speaking, the factor consistency tends to be satisfactory except for the factor O-D. The stability of the test as reported by others also appears to be high. U. Pareek (5) in his study of the reliability of the children's form (Indian adaptation) reports high factor stability and item reliability.

Procedure

A group of 50 subjects (25 boys and 25 girls) of the age group 13-17, was used for this study. All the subjects were of the same school and of the same class. The P-F study was administered to the students in a class room situation by the author. After a period of one month, it was again administered. The protocols were scored by the author immediately after each administration of the test.

Results

The test-re-test protocols were analysed in terms of the factors and also the identity of scorings of each item. The reliability (stability) coefficients of the scoring factors ranges from .36 to .70. The following table gives the coefficients for the nine scoring variables.

TABLE 2
Matrix Reliability Coefficients

	O-D	E-D	N-P	Percentages
E	.66	.57	.60	.70
I	.36	.45	.49	.52
M	.56	.55	.54	.70
Percentages	.68	.32	.41	

The analysis of the item scorings of the test-re-test reliability was found out by the same method used for finding out the inter-rater-reliability. The following table shows the percentages of agreement between the test-re-test scorings. The percentage ranges from 50 to 75, which indicates satisfactory reliability of the items.

TABLE 3
Item Reliability

Situations	...	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Percentages	...	61	50	70	67	60	59	75	68	71	66	70	61	50	64	68

Discussion

The figures reported in Tables 2 and 3 (both for matrix and item reliability) indicate satisfactory reliability of the instrument. These results exceed all the other results reported by previous investigators except that of U. Pareek. His reliability coefficients both for factors (.51 to .78) and items (56 to 91 per cent) are higher compared to the results obtained in the present study. If practice effects were to operate, then our reliability coefficients and item reliability should have exceeded that of U. Pareek as he conducted the re-testing after a period of 2½ months whereas the interval was only one month in the present study. We feel that one month interval in studies of this sort is quite ample to eradicate practice effects. It also helps to prevent the influence of maturational factors which is inevitable with longer intervals, particularly in children of this age group.

Summary

The reliability of a new Picture-Frustration study has been reported in this paper. The percentage of agreement between two independent raters and the stability of the responses over a period of one month have been presented.

The median percentage of agreement between the raters in the final stage was 89 per cent.

The 'matrix of reliability' coefficients for the scoring factors showed a range of .36 to .70. The 'identity' of the responses of the test-re-test protocols showed an agreement ranging from 50 to 75 per cent.

On the basis of the above results compared to the results obtained by the previous investigators, we may conclude that the reliability of the New P.F. study was satisfactory.

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Comparison of the Performance of Engineering and Non-Engineering Students on a Test of Spatial Ability

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Spatial ability is involved in tests which require the subjects to comprehend and manoeuvre geometric forms and other abstractions of objects in space. Subjects who possess this ability to a high degree are expected to do well in those studies and occupations that require visualizing or thinking about things in visual form (6). The factor of spatial ability has been identified most frequently in the factor studies of tests. It appears in the tests requiring the subjects to react to spatial relations, to read plans or blue prints or to tell quickly whether two drawings represent the same or opposite sides of such asymmetrical figure (4). This type of visualization has been assumed to be very important for engineering courses and the occupational engineering. Hence it might be expected that a test of spatial ability would be appropriate for selecting students for engineering courses. The existing selection batteries for such courses include achievement tests in mathematics, physics and chemistry. Besides the knowledge of these subjects, the success in these courses depends on some specific abilities. The demonstration that a spatial ability test can differentiate between engineering and non-engineering subjects, should provide an empirical basis for including a spatial ability test in the selection battery for admission to engineering courses.

Various tests of spatial ability have been developed from time to time. Some of them have been found to have predictive value and may be mentioned here. Link's Spatial Relation Boards Test which after revision became the Minnesota Spatial Relations Test (9) has been found to have validities of .35 to .44. Validities for this test were computed against a combined shop-criterion score which was the average of the course final grades. For the Crawford Spatial Relation Test, correlation with grades in the courses was found to be .47 (corrected). Validities for The Case-Ruch Survey of Space Relations Ability (9) were found to be (i) .39 for elementary electric shop, (ii) .39 for advanced electric shop, (iii) .62 for electric shop radio, (iv) .34 for elementary auto shop, and (v) .34 for elementary woodshop. Besides these there are other tests of spatial ability which have been found useful.

The present study was undertaken with two objectives in view. First, to develop a test of spatial ability which would be applicable in India as well as elsewhere for use in selection for courses and occupations requiring spatial ability. Secondly, to demonstrate the effectiveness of such a test in differentiating between engineering and non-engineering subjects. The level of education assumed for application of such a test was high school, hence very simple geometrical figures have been used. The test was planned to be appropriate for selection of students for engineering courses as well as for occupations requiring spatial ability.

Materials and Methods

The Figure Assembly Test which was constructed for the above-mentioned purposes, is a paper-and-pencil test. There are three sections of 20 items each in the test. For each section the key figure is different, *i.e.*, for Section I a square, for Section II a triangle; and for Section III a circle. Each item consists of 3 groups of pieces marked 'A', 'B', and 'C' and in each group there are 2 to 5 pieces. The subject is required to select the group for which the pieces, when joined together, will make the key figure. The pieces could be visualized in any rotated or reversed position. There is only one group of pieces which will make the key figure. If no group of pieces makes the desired figure for an item, the answer to that item will be 'D' which means that none of the 'A', 'B' and 'C' groups makes the desired figure.

The test was administered in different parts of India. The test was in the form of printed booklet with the instructions for the subjects printed on the front page. The subjects were allowed 40 minutes to complete the whole test, *i.e.*, 60 items. To record the answers, separate answer sheets were provided. The supervisors were instructed to make sure that the subjects understood the instructions clearly before starting to answer the test. The test was administered to 678 students of engineering and non-engineering courses. The engineering course requires 5 years and the engineering group tested consisted of students from III year (junior), IV year (senior) and V year. The non-engineering group consisted of students in the regular 4 years college course (referred to as Arts), a graduate course in teaching (referred to as B.T. and L.T.) and a graduate course in statistics. The test was administered in seven colleges or institutions, which have been assigned code numbers. Scoring was done with the help of stencil scoring keys, and right scores of the subjects were taken as the raw scores for the purpose of analyzing the results.

Results

Reliability, the standard error of measurement, and descriptive statistics, *i.e.*, mean and standard deviation, were computed for different classes within engineering and non-engineering groups and also for the totals of these two groups (excluding statistics graduates). Reliability was estimated from the odd-even correlation corrected by the Spearman-Brown formula. The values are presented in Table 1.

TABLE 1
Mean Standard Deviation, Reliability and Standard Error of Measurement for Engineering and Non-engineering Classes on the Figure Assembly Test

No. (1)	Group (2)	Class (3)	College No. (4)	N (5)	Mean (6)	S.D. (7)	r_{tt} (8)	SE M (9)
1	Engr.	III year (Mechanical) ...	1	65	27.25	5.19	.58	3.37
2		IV year (Civil) ...	"	48	28.83	5.02	.80	2.26
3		IV year (Electrical) ...	"	39	26.90	5.27	.67	3.00
4		III year (Agricultural) ...	2	32	24.28	4.08	.29	3.43
5		IV year (") ...	"	16	23.69	5.36	.33	4.40
6		V year (") ...	"	24	20.21	4.92	.76	2.41
Total (Engineering) ...				224	25.19	4.97	.60	3.14

TABLE 1—(contd.)

Mean Standard Deviation, Reliability and Standard Error of Measurement for Engineering and Non-engineering Classes on the Figure Assembly—(contd.)

No. (1)	Group (2)	Class (3)	College No. (4)	M (5)	Mean (6)	S.D. (7)	r_{tt} (8)	SE M (9)
7	Non-Engr.	I year ...	4	96	19.50	6.02	.75	3.01
8		II year ...	"	58	20.71	4.28	.58	2.78
9		III year ...	3	56	17.75	5.18	.69	2.90
10		IV year ...	"	28	17.21	6.18	.79	2.84
11		B.T. ...	5	160	18.82	5.28	.60	3.33
12		L.T. ...	6	27	18.96	5.07	.58	3.30
Total (non-engineering)				425	18.82	5.33	.67	3.03
13	Statistics	Graduates ...	7	29	24.21	5.85	.77	2.81

Performance of engineering and non-engineering subjects was statistically compared. To judge the significance of differences between the mean scores of the groups, *t* test and critical ratio were employed. The *t* test was employed where *N* was small and critical ratio where *N* was sufficiently large. The obtained values of *t* and critical ratio along with their level of significance have been shown in Table 2.

TABLE 2
Statistical Comparison of the Performance of Engineering and Non-engineering Subjects on the Figure Assembly Test

No.	Class		College		N		Mean		Test of Significance	Level of Significance
(1)	Engineering	Non-engr.	Engr.	Non-engr.	Engr.	Non-engr.	Engr.	Non-engr.	(10)	(11)
1	III year (Mechanical)	III year (Arts)	1	4	65	58	27.25	20.71	7.58*	.01
2	III year (Agricultural)	III year (Arts)	2	3	32	56	24.28	17.75	6.47*	.01
3	III year (Mechanical) IV year (Civil) IV year (Electrical)	III year (Arts) B.T.	1	4, 5	152	218	27.66	19.33	15.15**	.01
4	III year (Agri.) IV year (") V year (")	III year (Arts) IV year (Arts)	2	3	72	84	22.79	17.57	6.14**	.01
5	III year (Mechanical) IV year (Civil) IV year (Electrical)	III year (Agri.) IV year (Agri.) V year (Agri.)	1	2	152	72	27.66	22.79	6.67**	.01

* = *t* value

** = critical ratio.

Table 3 presents the statistical comparison of the mean scores of statistics graduates with engineering and graduates in liberal arts and of boys and girls. The performances of boys and girls were compared to see the differences in spatial ability due to sex using the t test and the obtained values of t are given along with their level of significance in Table 3.

TABLE 3

Statistical Comparison of the Performance of Boys and Girls and of the Students of Electrical Engineering and Statistics Graduates on the Figure Assembly Test

No.	Class	College No.	N	Mean	Value of t	Level of Significance
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	IV year (Electrical Engr.) ...	1	39	26.90	1.92	Insignificant
	Statistics graduates ...	7	29	24.21		
2	L.T. (Teaching Diploma) ...	6	27	18.96		
	Statistics graduates ...	7	29	24.21	3.52	.01
3	B.T. (Boys) ...	5	101	19.29	1.45	Insignificant
	B.T. (Girls) ...		59	18.03		
4	III year (Boys) ...		40	21.65		
	III year (Girls) ...	4	18	18.61	2.30	.05

To demonstrate how the test actually discriminates between engineering and non-engineering subjects, frequency distributions have been prepared. Percentage frequencies were obtained by equating the total frequencies of each group to 100. For allocation of future students to engineering and non-engineering, the percentage of engineering and non-engineering falling in each test score interval has been computed. Percentage frequency distributions and percentage allocation of engineering and non-engineering subjects have been presented in Table 4.

TABLE 4

Frequency and Percentage Frequency Distribution and the Percentage Allocation in Different Test Score Intervals of Engineering and Non-engineering Subjects on the Figure Assembly Test

Test Score	Mid-point	Frequency			Percentage frequency		Percentage allocation of subjects		
		Engr.	Non-engr.	Total	Engr.	Non-engr.	Engr.	Non-engr.	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0 — 4	2	0	5	5	0	1.18	0	100.00	100.00
5 — 9	7	0	12	12	0	2.82	0	100.00	100.00
10 — 14	12	2	64	66	.89	15.06	3.03	96.97	100.00
15 — 19	17	27	151	178	12.05	35.53	15.17	84.83	100.00
20 — 24	22	56	120	176	25.00	28.23	31.82	68.18	100.00
25 — 29	27	76	64	140	33.93	15.06	54.29	45.71	100.00
30 — 34	32	49	9	18	21.87	2.12	84.48	15.52	100.00
35 and above	37	14	0	14	6.25	0	100.00	0	100.00
Total		224	425	649	99.99	100.00	34.51	65.49	100.00

The percentage allocation of the two groups is presented graphically in Figure 1. In Figure 1 two curves showing the percentage allocation of engineering and non-engineering subjects have been drawn separately on the same abscissa and ordinate. They have been drawn from the data in columns 8 and 9 of Table 4. The two curves intersect each other at the score of 26.

Correlations between test scores and final examination marks for non-engineering subjects have been found to be .06 for 1 year, .20 for III year and .24 for B.T. (graduate course in teaching) classes.

Discussion

To estimate the reliability of the test, the split-half method was used. Odd-even correlations were corrected for length by the Spearman-Brown formula. These values are given in Table 1. For engineering subjects the reliability coefficients range from .29 to .80 with a combined r_{tt} of .60 and for non-engineering subjects the r_{tt} ranges from .58 to .79 with a combined r_{tt} of .67. The combined r_{tt} was obtained by averaging the r_{tt} values of all the classes using the z transformation. For statistics graduates r_{tt} was computed separately and was found to be .77.

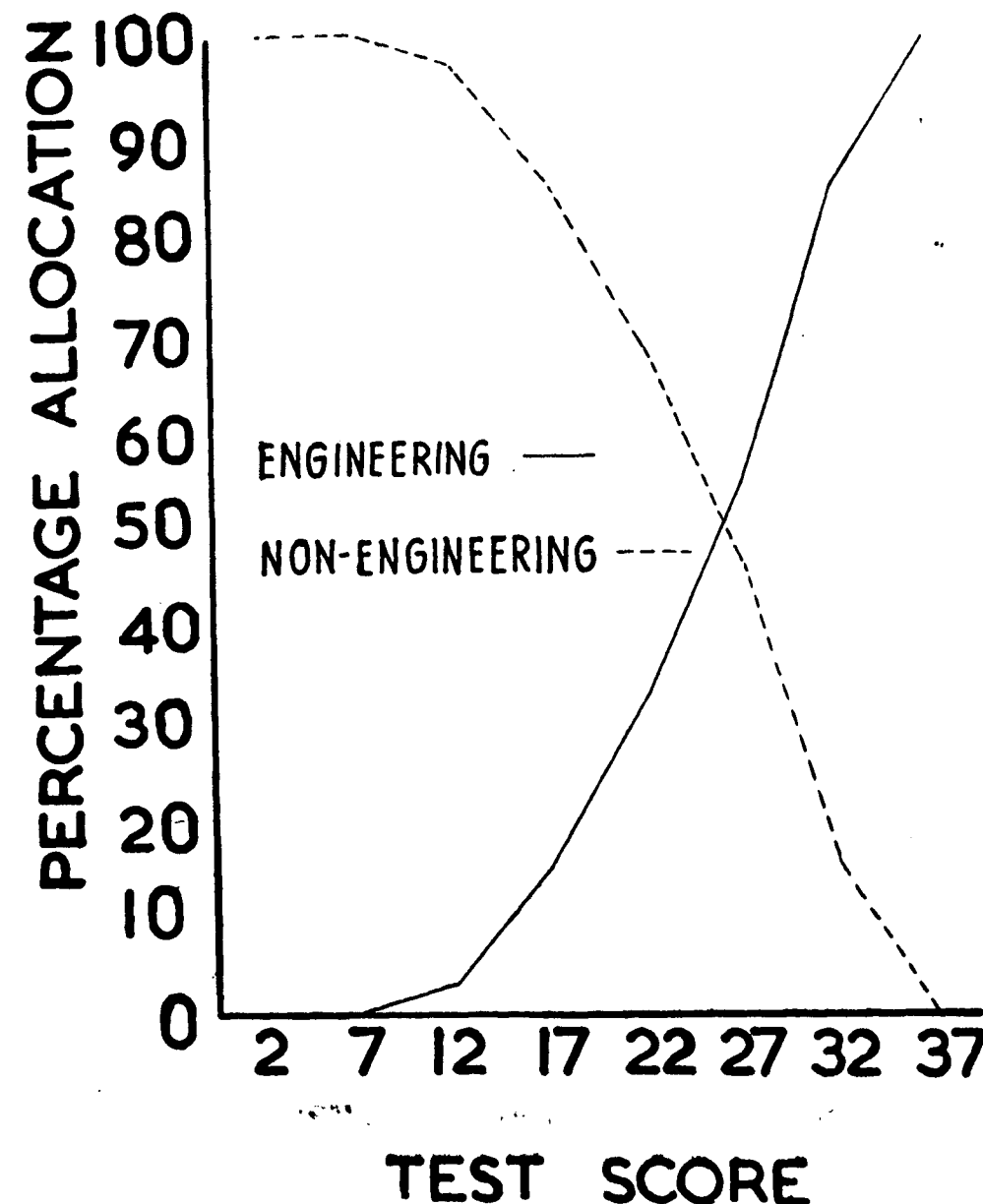


Fig. 1. Curves illustrating the Percentage Allocation of Engineering and Non-engineering Subjects for Different Test Score Intervals of the Figure Assembly Test.

In order to see how effectively the test differentiates between engineering and non-engineering subjects, statistical comparison of the mean scores of the two groups was made. The engineering subjects have been found to be significantly ($P < .01$) superior than the non-engineering subjects in performance on the Figure Assembly Test (see Table 2).

For using the test in selection a critical score can be proposed. A critical score of 26, where the curves for percentage allocation of engineering and non-engineering subjects intersect, can be used. Using 26 as the critical score we shall select non-engineering subjects with a probability of .08 and engineers with a probability of .44. In view of the fact that setting up any critical score depends upon the demand and supply of the candidates, several critical scores can be proposed on the basis of the present data. For selecting 62, 55 and 40 per cent of the total number of engineering candidates, the critical scores of 24, 25 and 27 may be used respectively.

Some very interesting and potentially useful findings have been revealed by the present study. The test scores are not influenced by academic achievement in the liberal arts subjects. The correlation coefficients between test scores and final examination marks (for non-engineering subjects) have been found to be .06 for I year, — .20 for III year and .24 for B.T. classes. The values for I year and III year classes are not statistically significant; but for the B.T. class the value is significant ($P < .05$). These findings are in agreement with those of Fruchter (4) who writes that spatial ability is unrelated to academic performance with the possible exception of a few very specialised courses such as engineering drawing. Significant differences have been found in the performance of boys and girls on the test. Two groups of boys and girls have been compared and in both the cases the boys have been found to be superior to the girls (Table 3), however the differences were significant ($P < .05$) for one group only. These findings also confirm those of Fruchter (4) who writes that boys excel girls in spatial ability. The performance of statistics graduates was compared to IV year (senior) electrical engineering students but no significant difference was found. When compared with liberal arts graduates, the statistics graduates were found to be significantly higher. These results suggest that the students of higher mathematics and statistics possess high degree of spatial ability.

Summary

The findings of the present study may be summarised as follows :

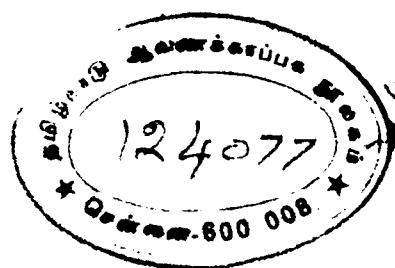
- (1) The reliability coefficients for engineering, non-engineering groups and statistics graduates on the Figure Assembly Test are .60, .67 and .77 respectively.
- (2) The engineering subjects are significantly ($P < .01$) superior to non-engineering subjects in performance on the test.
- (3) The critical scores of 24, 25, 26 and 27 have been proposed for selecting 62, 55, 44 and 40 per cent of the total number of engineering candidates.
- (4) Test scores do not correlate with examination marks.
- (5) Boys in liberal arts courses obtain significantly higher scores than girls on the test.
- (6) Statistics graduates possess a high degree of spatial ability.

Acknowledgements

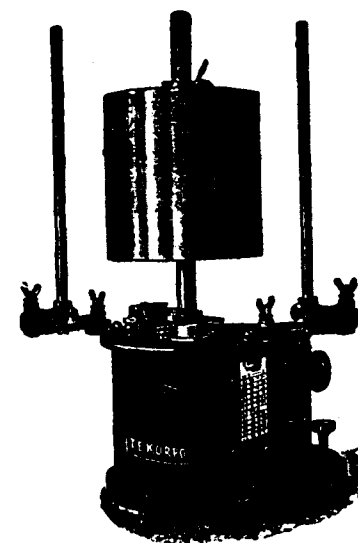
Our grateful thanks are due to Dr. Rhea S. Das without whose constant guidance the development of the test and subsequent report would not have been possible. We are also thankful to the authorities of the institutions where the test was administered and the subjects who co-operated in the project. Special acknowledgement is due to Dr. A. E. Harper, Jr., Dr. H. C. Ganguli and Mr. K. G. Garg and Mr. C. R. Jindal who helped us by administering the test at their institutions.

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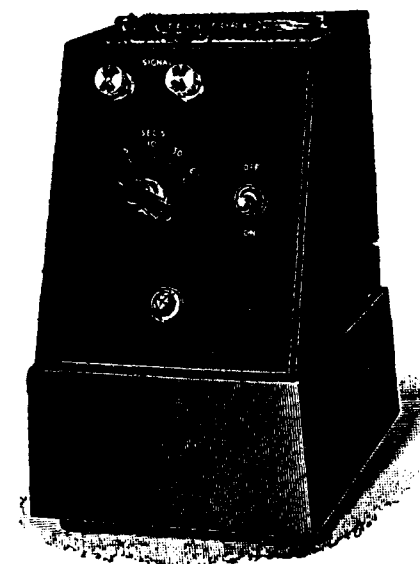
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